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Why Stars Twinkle—Railroading Today

SCIENTIFIC AMERICAN

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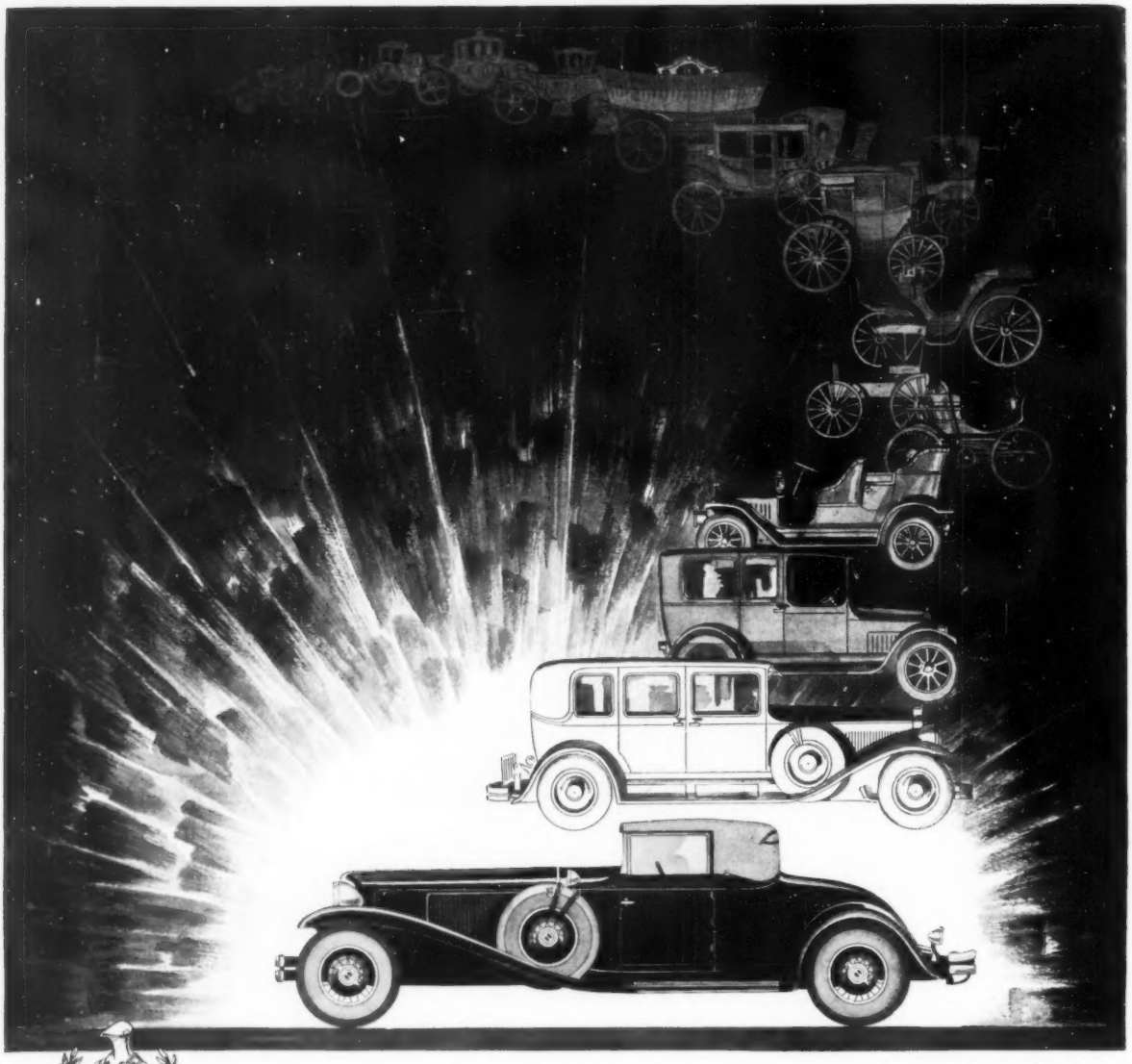
Glowing Rift Oven at Kilauea Crater, Hawaii



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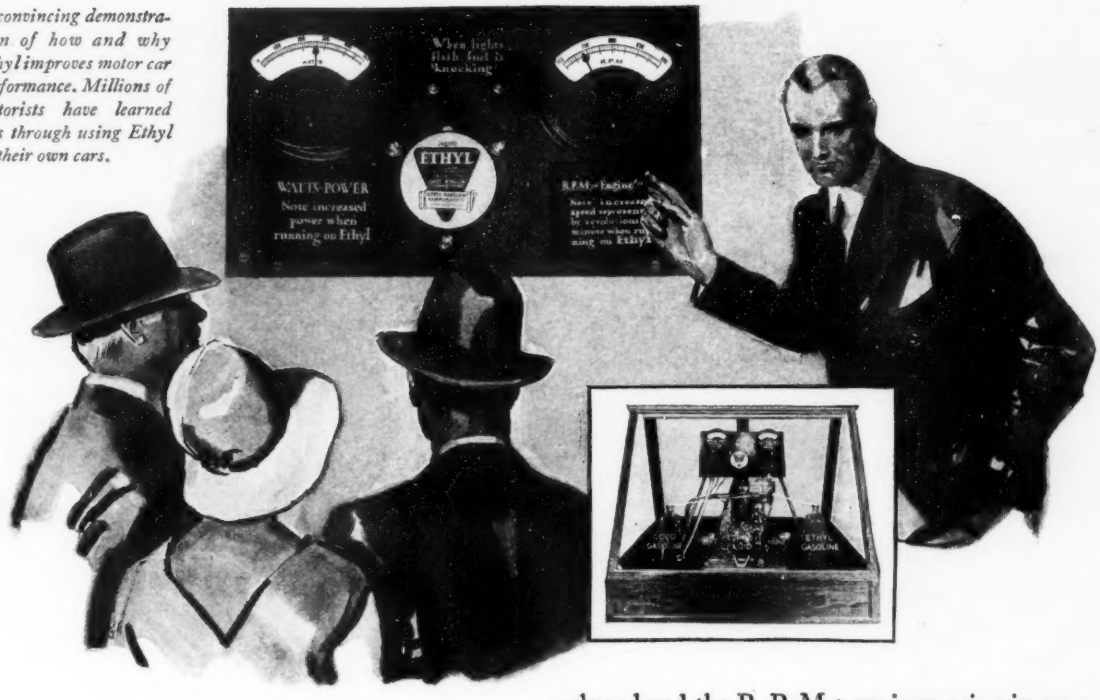

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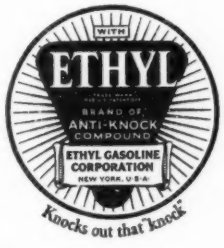

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The active ingredient used in Ethyl fluid is lead.

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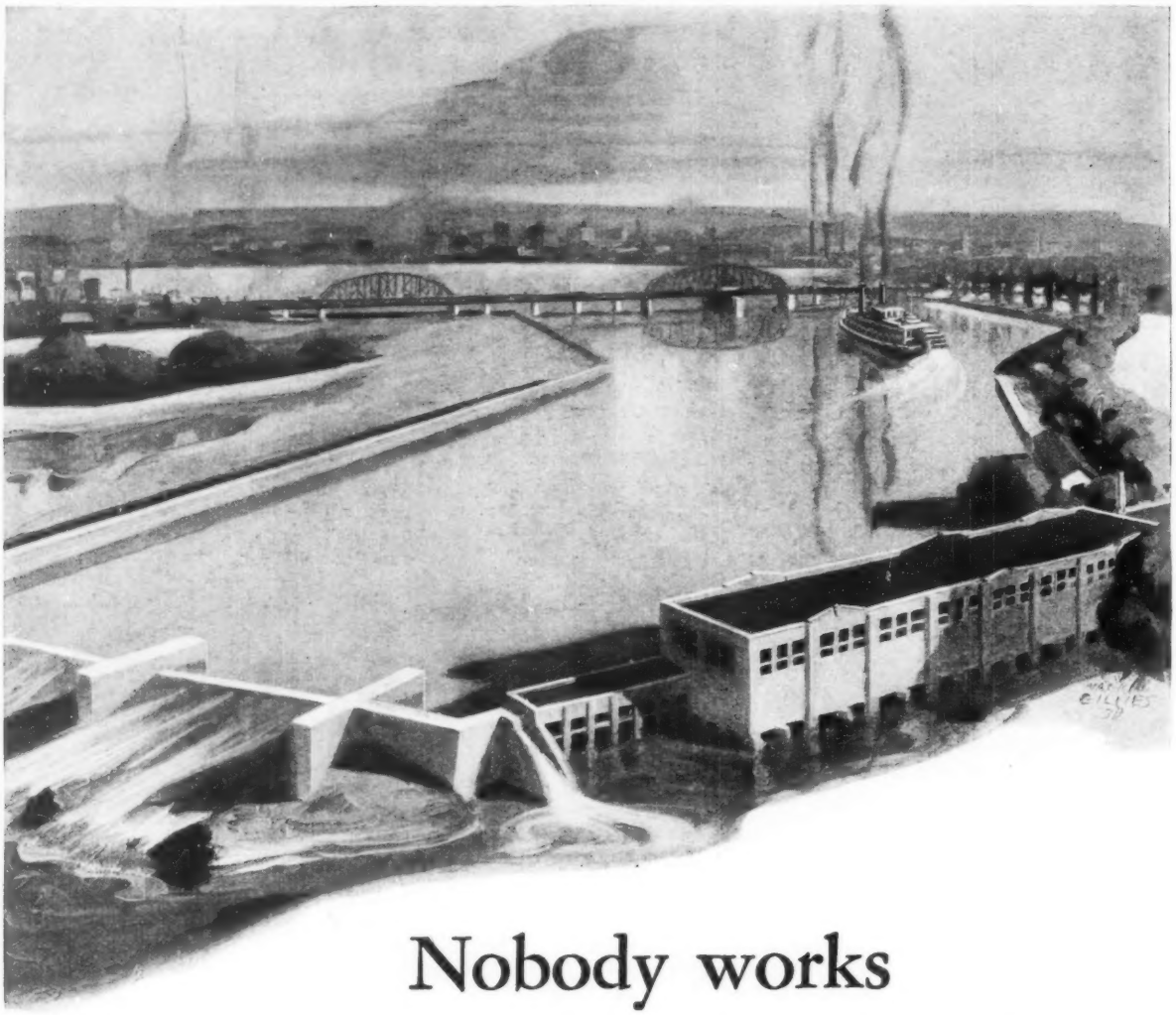

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SCIENTIFIC AMERICAN

September, 1930 — *ORSON D. MUNN, Editor* — *Eighty-sixth Year*

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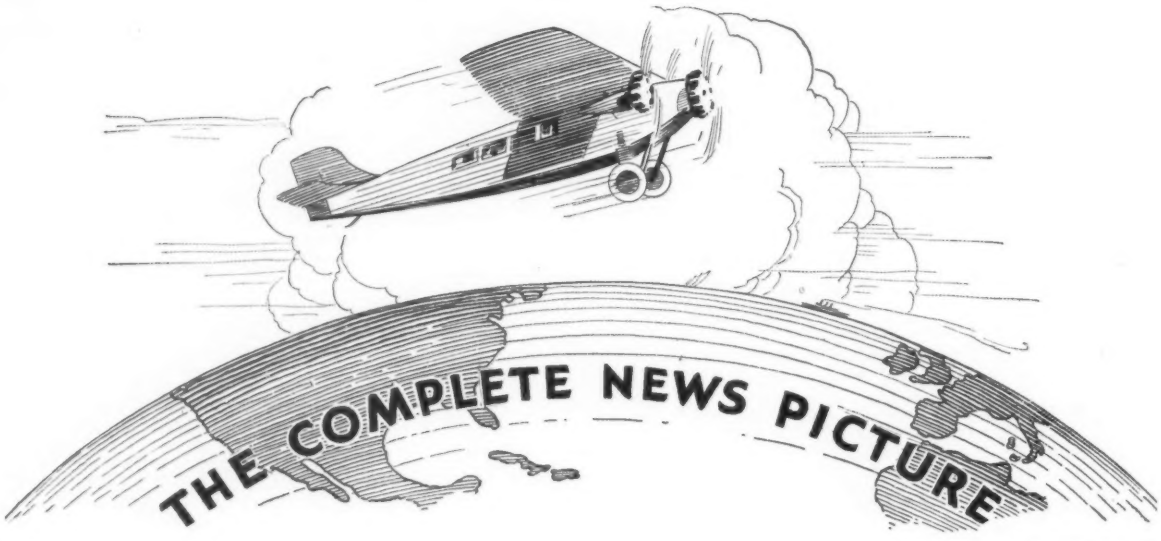
COVER

The vast crater depression of Mt. Kilauea, Hawaii, contains numerous features, one of which is the little "rift oven" shown on our cover, which developed over a rift or crack. The oven "breathed and puffed," says Dr. T. A. Jaggar (see page 176), "lava was visible far down the shaft, pale flame played around the orifice under whose lip the interior chamber was bright orange with incandescence, and hung with delicately sculptured fiery stalactites."

See the Whole World Each Month!



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Across the Editor's Desk

As this is written we have before us the advance printer's proofs of the feature articles for this issue. Going through them, page by page, we stopped and reread the article "Railroading Today." No less than when we first read the manuscript, did it bring us face to face with the gripping romance of the mighty networks of steel that have united the far reaches of this country by providing safe and rapid transportation. Old yet always new, the story of railroading in its ever-changing phases holds a unique fascination, probably because it is so intimately interwoven with the very fabric of our every-day existence. We feel sure that you will agree with us that Mr. Milholland is to be congratulated on the story he has written for you this month.

Another article to which we particularly want to call your attention is the one by Dr. T. A. Jaggar on "Volcanology." Dr. Jaggar spends his whole time at the crater of the active volcano Kilauea in the Hawaiian Islands. Thus he is qualified to write with the pen of authority on how the science of volcanology has a direct bearing on the daily lives of each and every one of us, and for that reason his call for amateur seismologists will not go unheeded. Whether you live in the Adirondacks, West Virginia, or on the Pacific Coast, you may, if you answer Dr. Jaggar's call, contribute valuable data to the science of volcanology. Here's hoping that many of our readers will go in for amateur seismology with the same enthusiasm that has been manifested for amateur telescope making.

As long as the evolution of organic life—animals and plants—remains uncertain, there will be two sides to each and every question that arises. Thus, when Dr. Austin Clark expounded *his* theory in our August issue, we felt it only fair to open our pages to any logical refutation of his statements that might be brought forth. And forth it came. Professor Matthew, a paleontologist of high standing, presents *his* side in a masterful article on page 192. Which authority is right? Each reader will have to study the two presentations carefully—and then draw his own conclusions. We remain open-minded.

The Peking man—or woman, to be exact—is fast growing in importance. Professor G. Elliot Smith, who is one of the world's first five authorities on the subject involved, which is called "paleoanthropology," has written an article for you on the Peking man which we feel sure you are going to find of great interest.

These are only some of the high spots that stand out as we scan our proof sheets. Other articles of equal interest and importance cover such subjects as the truth about our much abused patent system; the new type of racing car that is bound to make new history on the speedways; what surgery is doing to rehabilitate cripples; the yachts that have been built to defend the America's Cup; and a dozen or more selected subjects—not to forget the SCIENTIFIC AMERICAN Digest that brings to you the news of all the sciences in brief.

So now we turn to the schedule of the October issue. Of course it is not complete, space having been reserved for important features that are bound to come up at the last minute. But we can tell you something of the articles that are ready for release. Signaling to Mars, that much abused subject so dear to the hearts of the so-called popular magazines, has at last been treated in a logical manner. Even if we could get visual or electrical signals through to the red planet, how could we be sure that there are intelligent creatures there to receive them—humans or animals made up of protoplasm, which is the only criterion of living matter in our experience?

A 69-inch mirror has been cast for a telescope in the Perkins Observatory, as told in an article illustrated by a most unusual series of photographs. And there is a touch of human interest in the background. The funds for the telescope, 330,000 dollars, were provided by the will of the late Professor Perkins of Ohio Wesleyan University. This sum represented the life savings of an 1800-dollar-a-year professor, accummulated through numerous sacrifices on his part and that of his wife, invested judiciously and allowed to flourish at compound interest. Just as the professor devoted his life to science, so did he provide for the continuation of his work after his death.

These articles are by no means all we have to offer for October. The issue will be replete with interest for the astronomer, professional or amateur; several major articles will assure that. There will also be discourses on the cricket's chirp; a gun mount that makes a super-weapon of the 75-millimeter gun; mining of a valuable metal that is recovered from ore by evaporation; the aircraft industry; the sphere in which William Beebe descended deeper into the ocean than man has ever dived before; and other absorbing subjects. All in all, we feel that the October issue will be one of the best we have given you in many months.

Orson D. Munn

Uncle Sam says

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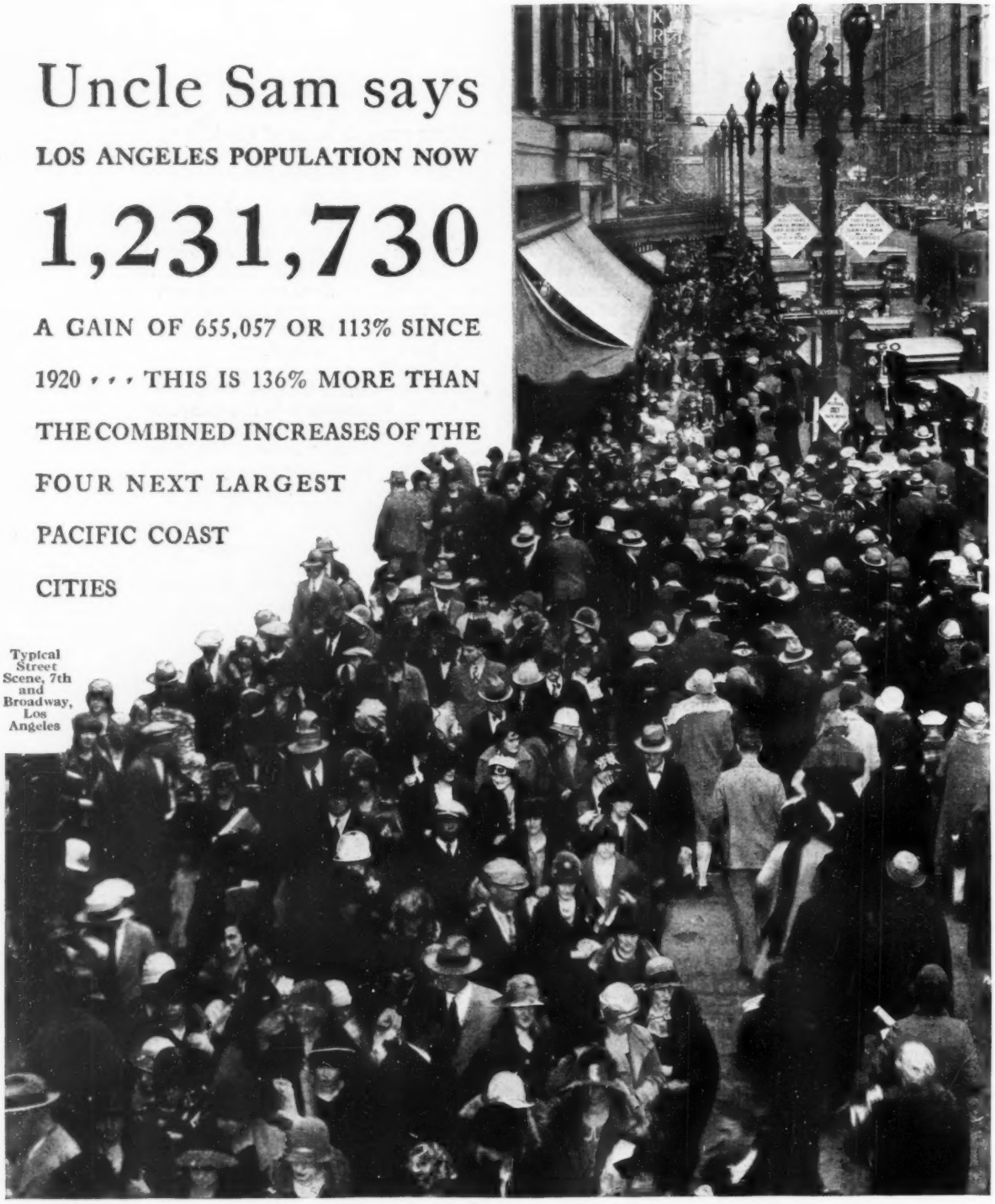
A GAIN OF 655,057 OR 113% SINCE 1920 . . . THIS IS 136% MORE THAN THE COMBINED INCREASES OF THE FOUR NEXT LARGEST PACIFIC COAST CITIES

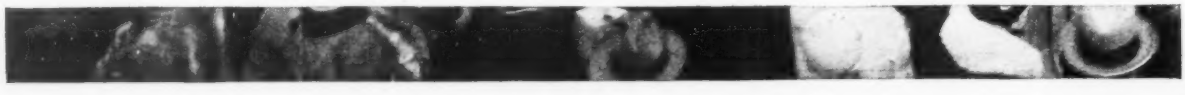


Typical Street Scene, 7th and Broadway, Los Angeles

Industrial Los Angeles *County*

POPULATION 2,199,657

MANUFACTURING EXECUTIVES ARE INVITED TO WRITE TO THE INDUSTRIAL DEPARTMENT, LOS ANGELES CHAMBER OF COMMERCE, FOR DETAILED INFORMATION REGARDING THIS GREAT WESTERN MARKET



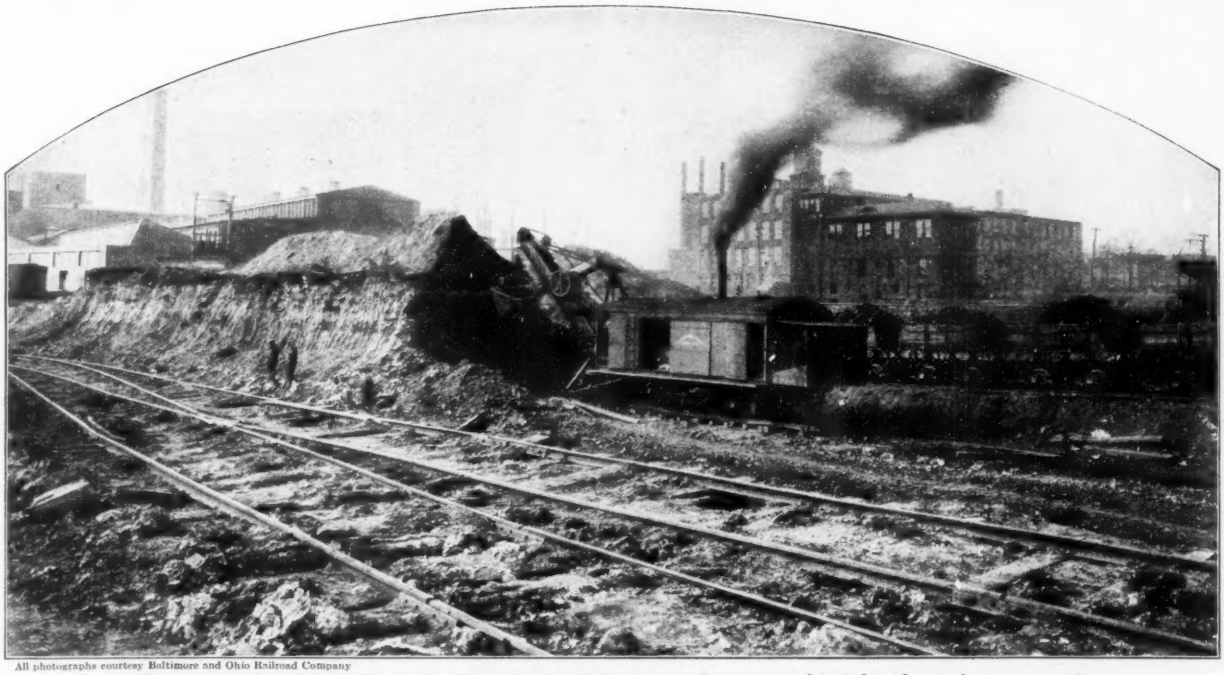
Frank B. Jewett

AN electrical engineer and physicist by training, Dr. Jewett is President of Bell Telephone Laboratories. Here are gathered more than 2500 engineers and scientists with a budget of 17,000,000 dollars. As Vice President of the American Telephone and Telegraph Company, Dr. Jewett also directs the activity of another large technical group. In the 25 years of his association with the Bell System, his guidance has contributed to a myriad of betterments in telephone service, as well as to such advances as transcontinental and transatlantic telephony, the dial system, radio broadcasting, and the high speed submarine telegraph cable. During these busy years he found time to be the head of the American Institute of Electrical Engineers and chairman or active worker in several committees of national importance in the engineering world. The ability to carry forward a number of projects at once is a characteristic which rests mainly upon quickness of perception and accuracy of analysis. All of these traits have aided largely in Dr. Jewett's spectacular progress. That he could enlist the co-operation of hundreds of scientists and engineers is a marked, outstanding tribute not only to his professional ability but to the frankness and sincerity which illuminate his personality.

Courtesy Baltimore and Ohio Railroad Company

The Vanguard of Progress

WRITERS of fiction have woven many romantic stories around the coming and going of the engineers on railroad construction, their loyalty to their jobs, their unceasing efforts to conquer nature and wrest from it a route, in spite of storms, floods, and natural obstacles of all kinds. The engineers who blazed the trails when railroads were new and stretching into the timberlands and the coal fields, were inured to the hard labor of the pioneer. Now, however, the fastnesses of the highest mountains having been penetrated and the paths of commerce clearly marked, the work of the railroad civil engineer, with improved methods and machinery, is less romantic. In former years when railroads were building, these men of the rod, the chain, the level, the stake, and the transit, were found delving into the wilderness, looking for the "saddle" that would get them over the summit. Everyone of the "gang," from the engineer in charge and transitman, down to the lowly stake man and "back rodman," worked hard and long, often under trying conditions—cold and heat—often braving great dangers. Most of the territory has now been covered and the work of the railroad civil engineer is mostly on small projects and maintenance work, except in undeveloped countries of the world.



All photographs courtesy Baltimore and Ohio Railroad Company

The steam shovel does the work of hundreds of laborers and prepares the right of way for new track

Railroading Today—
Construction and Maintenance

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice-President, Baltimore and Ohio Railroad Company

WHO has not, at one time or another, gazed down the length of a straight-away stretch of railroad track and found a fascination in watching the steel rails converge to a vanishing point in the distance? But how many of us know the story, equally fascinating, of how those rails were put there and how they are kept so straight and true—the story, in short, of the construction and maintenance of a railroad?

Let us start from the very beginning of this undertaking and consider some of the many problems involved. First, of course, there is the present or probable future need of a railroad as a means of transportation between two definite points. When this has been determined, a corps of field engineers or surveyors start to map out the best and most economical route. From their observations they prepare plans so that the necessary right-of-way can be purchased. They also draw up plans and specifications for the use of the contractor who will do the work of grading.

Now comes the big job of preparing the grade on which the railroad tracks will be built. In this work it is interesting to compare efficient modern methods with the crude means used when the first railroads were built. In former decades, when it was necessary to cut through a hill or along a hillside, the dirt was plowed loose and hauled away with a horse-drawn scraper. When rocks were encountered, the men drilled holes in them with a hand drill and blasted with slow-burning black powder. Then came the steam shovel and the dinky dump cars run on a narrow-gage track, which were big steps forward in promoting speed and economy of operation.

TODAY, automobile dump trucks are used and even the steam shovel is being supplanted by the tractor or crawler shovels run by gasoline or oil engines. Steam-operated hammers drill the rocks for blasting and dynamite takes the place of black powder.

At the same time that cuts and fills are being made to obtain a uniform grade line, culverts and bridges have to be built, large or small, according to the size of the stream and the maximum amount of rainfall that might be expected during a given time. Particular attention is given to the

A pneumatic hammer speeds the work of driving spikes into the ties

The new track is set in the proper position with the aid of a track gage and is being fastened to the ties by trackmen

possibility of eliminating grade crossings.

As the work of preparing the finished subgrade of the road progresses, materials for the construction of the tracks are assembled at the job and then distributed to place. For the track structure of today 22 treated ties are laid for every 39 feet, which is the length of a steel rail. This is followed by the distribution of the steel rails, joint fastenings, bolts, tie plates, spikes, and rail anchors.

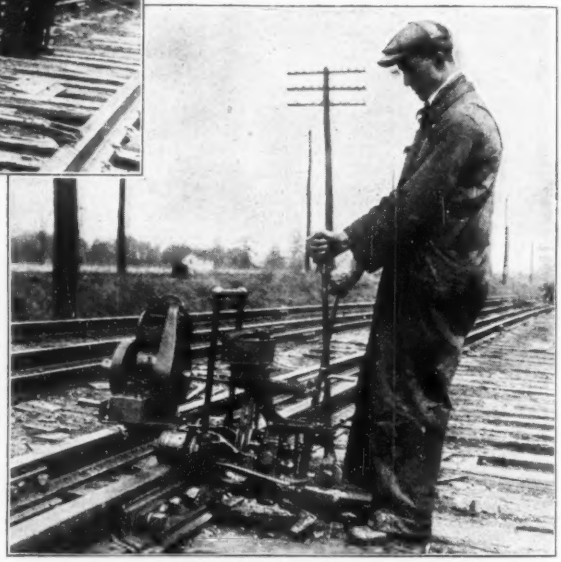
THE distribution of track material is quite an undertaking and the manner of handling depends entirely upon local conditions. Where additional tracks are built parallel with existing tracks, the problem is simple, as the material is unloaded right where it is to be used from cars handled by a work engine.

Where the track is on a new line, however, the problem is more difficult. On large jobs a special track-laying outfit is utilized, consisting of a number of flat cars with special power-driven belt or roller conveyors attached to the sides. As the train proceeds to the end of the new track that has been laid, ties and tie plates are placed on one conveyor and carried ahead of the train, where they drop to the ground. The men immediately put these in their proper positions.

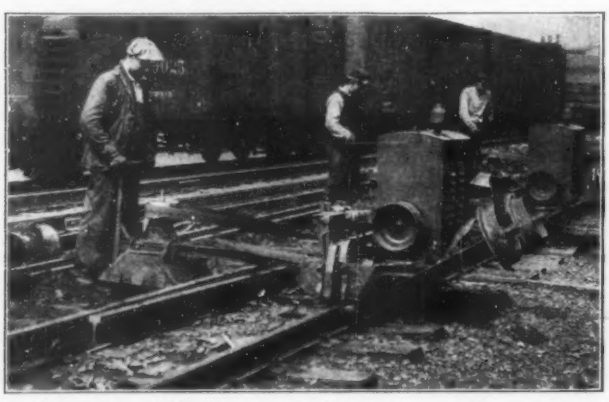
On the other conveyor, rail is carried ahead together with the joint fastenings, bolts, and spikes. A small power crane on the head end of the track-laying machine places the rail into position and the trackmen lay the joint bars and spike enough ties to permit the safe passage of the outfit.

To build one mile of single track railroad, the following material is required: 204 tons of 130 pound (per yard) steel rails; 270 joint fastenings, which with abrasion or rubbing plates weigh 141 pounds each; 5418 tie plates, weighing 16½ pounds each; 48 kegs of track spikes, weighing 200 pounds each; 15 kegs of track bolts, weighing 200 pounds each; 1650 rail anchors, weighing 2½ pounds each, or a total of 4125 pounds; 2979 treated cross ties, size, 7″ x 9″ x 8½′; 3600 tons of stone ballast. This represents about 89 carloads of material, the cost of which is 22,000 dollars. Labor adds 6000 dollars so our mile costs 28,000 dollars.

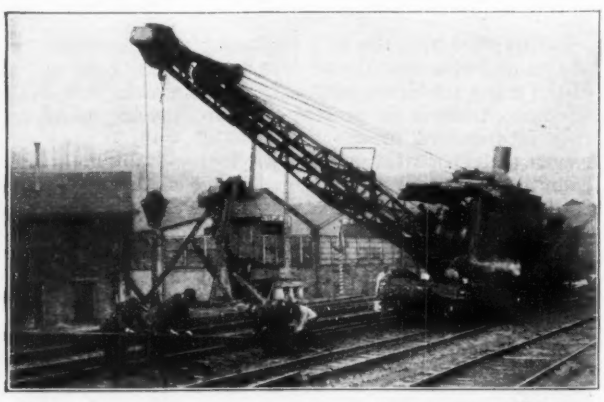
After the distribution of material, the ties are evenly spaced with the ends on one side in a straight line. The tie plates are then placed on the top face of the ties, using a gage, so that when the rail is placed on them, the inner or gage side of the rail heads will be exactly four feet 8½ inches apart. This is the distance that has been adopted as standard on all railroads in this country. As the rails are placed, "shims" or spacers are put between the ends to allow for the expansion and



The bonding drill helps to attach the bindings to ensure connections for the electrical currents



When the old rail is removed the ties are trimmed to a level bearing by power-driven adzing machines



The locomotive crane is seen putting a new rail in position. Rails are now too heavy for hand handling

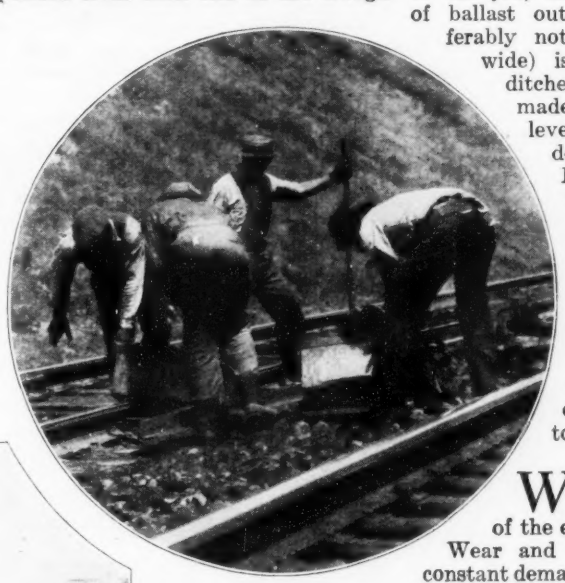
contraction of the steel, the size of the shim depending upon the temperature at that time.

With the rails set and the joint fastenings applied, one line of rail is spiked into place. The second line is next spiked to the ties conforming to the standard gage. Rail anchors are then placed to hold the expansion space between the rail ends uniformly. Next, the track is aligned according to the stakes set by the field engineer, and it is then ready for the ballasting operation.

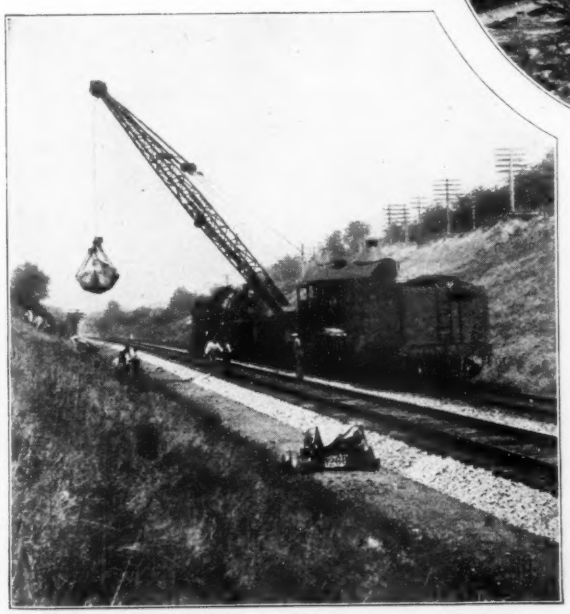
CARLOADS of engine cinders are brought in and dumped on the track. The trackmen raise the rails on these cinders until there is a mat 12 to 18 inches thick, extending over the width of the roadbed. Time is now allowed for settlement of the cinders and then when the roadbed has become stabilized, the cinders are "cribbed out" or cleaned out and used to widen the banks of the roadway, and new ballast, of stone, gravel or crushed hard slag, is distributed. The stone ballast is generally used in heavy-traffic high-speed territories. It is necessary to have from six to twelve inches of ballast between the bottom of the ties and the cinder foundation. This takes between 2200 and 3000 cubic yards of ballast, or from 55 to 75 carloads per mile of single track railroad. Ballast is normally handled in drop-bottom cars and as the work train moves ahead, the ballast, released through the bottom doors, drags out practically even with the top of the rails, giving a surplus on which to raise the track. The ballast is generally unevenly placed in this way, however, and the labor of distributing it where it is wanted and needed is quite an item.

This difficulty has been largely overcome by the automatic ballast spreader, a device designed to control the unloading of ballast from railroad hopper cars. It consists of a trough, the bottom of which is equipped with movable plates, permitting openings of the area required to distribute the quantity of stone needed. At each end of the trough are sheet steel plates also equipped with gates for regulating the flow from the end of the pan onto the ballast shoulder. Suspended from each end of the trough is an auxiliary pan called a shaper, which dresses the ballast shoulder to a section. A lever control lowers the distributor when in operation so that it rests on rollers which move forward on the rails. When not in operation, it is raised and carried suspended from the car. It is a great labor-saver.

A picturesque operation is the placing in exact position of a new rail on the leveled cross ties



A small machine called a "mole" is used to remove ballast between the tracks for cleaning and replacing



Shaping the hillside so as to intercept drainage from the tracks. A locomotive crane is used

After the material is distributed, the ballast is impacted under the ties either by hand (using shovel or tamping pick), or mechanically with pneumatic or electrically driven tools. There are two types of electric tampers, one using the direct hammer blow and the other employing vibration, to settle the ballast under the ties. To give a neat appearance to the job, the "berm" or shoulder of ballast outside the tracks (preferably not less than 12 inches wide) is built up uniformly, ditches are cleaned out and made regular and the ballast leveled off and dressed to a definite standard section. In addition to the building of the track structure, a very important item is that of drainage. Wet spots encountered in cuts are tiled and cross-drains installed. Ditches are cut to keep water away from the tracks, and every precaution taken to prevent undermining.

WITH the completion of construction, the work of the engineer is not finished. Wear and tear, increased by the constant demand for greater speed and heavier train loads, needs to be constantly remedied by replacements and repairs, which have to be made without interruption to traffic. This is the maintenance problem.

A slight insight into the magnitude of this important work may be gained from the following statistics covering the seven-year period of 1922–1928, inclusive, for the railroads of the United States:

Roadway and Structures

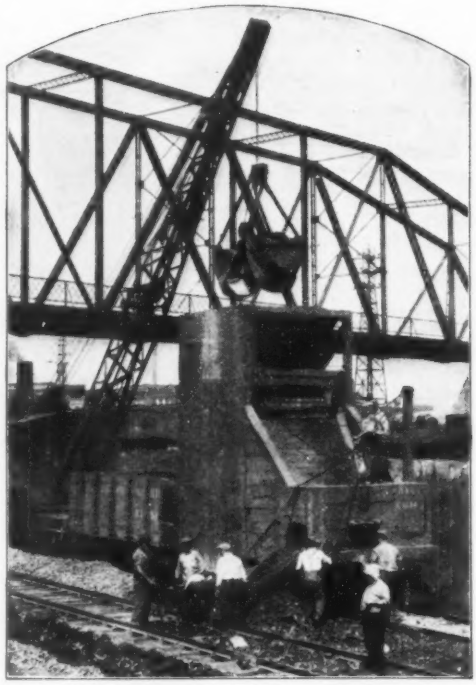
Additional track and track material	$ 843,981,000
Heavier rail	242,848,000
Additional ballast	85,879,000
Shops and engine houses	242,470,000
All other improvements	1,385,603,000
Total	$2,800,781,000

The annual program of maintaining a railroad calls first for the renewal or

replacement of rails that have become worn. New rail is generally laid out of face—that is, uninterruptedly, without patchwork—in stretches of from one to five miles on main-line high-speed tracks. Local conditions and the amount of rail to be laid determine the methods to be used.

Let us consider, as an example, the events of one day's work where a large amount of 130-pound rail was laid, replacing 100-pound rail. To organize this work thoroughly the supervisory forces determine from experience just how many men will be needed for each operation of work and how best to get the men to the point of work. Foremen are notified just what their men will be expected to do that day and come prepared with their tools. Further arrangements are made with the transportation department whereby the trackmen can have the uninterrupted use of this track for as long as possible.

Sufficient men are gathered so that each man can be assigned to a particular duty and to enable him to utilize the full work period. This eliminates the changing of tools and doubling men back and forth on the work. The operations are carried through in the following sequence: 1. Distributing new materials; 2. Pulling spikes; 3. Throwing old rail in about 12 inches from former position; 4. Removing old tie plates; 5. Plugging old spike holes in ties; 6. Adzing surface of ties to give a sound and level bearing for the new tie plates; 7. Placing new tie plates; 8. Setting new rail into place with a rail-laying machine. (This operation is frequently done with various types of cranes, some designed particularly for this work); 9. Placing joint fastenings and tightening two bolts per joint; 10. Spiking every 4th or 5th tie to proper gage; 11. Full bolting the joints; 12. Full spiking all ties; 13. Placing rail anchors to prevent change in the expansion space between rail ends from shifting the rails; 14. Installing bond wires connecting rails in automatic signal territory; 15. Throwing old rail out of track; 16. Disconnecting the old rail; 17. Assembling and classifying old material removed from track.



Fouled ballast must be cleaned in a special machine, after which it is replaced

Crews have telephones which are used to learn of train movements

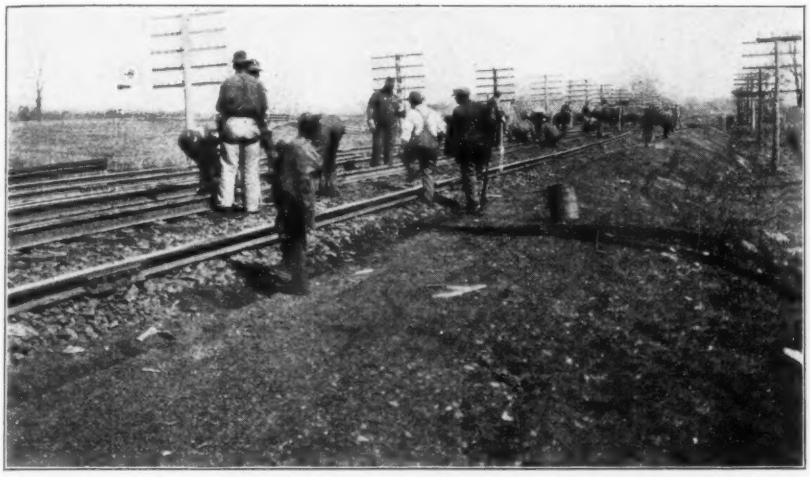
IN this manner it was possible to lay 20,000 feet of rail in one working day with a force of 120 men. With equipment now available, this force could be reduced, since in addition to the machine for setting in rails, there are power-driven adzing machines, power bolt-tighteners, and pneumatic spike-drivers.

Following the laying of the new rails comes the renewal of the cross ties and general rehabilitation of the track. Untreated ties decay rapidly and the average life is but from eight to nine years. With the general use of preservatives injected into the wood to check decay, the life of cross ties has been more than doubled. Ballast becomes fouled and blocks the proper drainage. To restore the drainage and re-establish the uniform grade line or surface of the rail, the ballast is cleaned and the track raised slightly so that fresh ballast may be impacted under the ties.

The rails themselves are subject to heavy wear at the joints because of the hammer blow delivered in the passage of the wheels from one rail to the next, battering out the metal at the joint and also the ballast under the ties. This causes a dip in the rail, referred to as a "low joint," which must be resurfaced and raised periodically. It is this condition that frequently limits the life of rail in main tracks.

More work is required on the maintenance of curves than on straight track, as the centrifugal force of trains passing over the tracks tends to force the weaker points out from the true circular curve, resulting in a bad riding condition. Such curves must frequently be remeasured, calculated,

Railroad ties by the thousands are stored in piles ready for use in the laying of new track or replacing old ties. Most of the ties are chemically treated



The new rail is placed as quickly as possible so as not to interfere with the movement of traffic and the old rail is slipped to one side and dismantled later

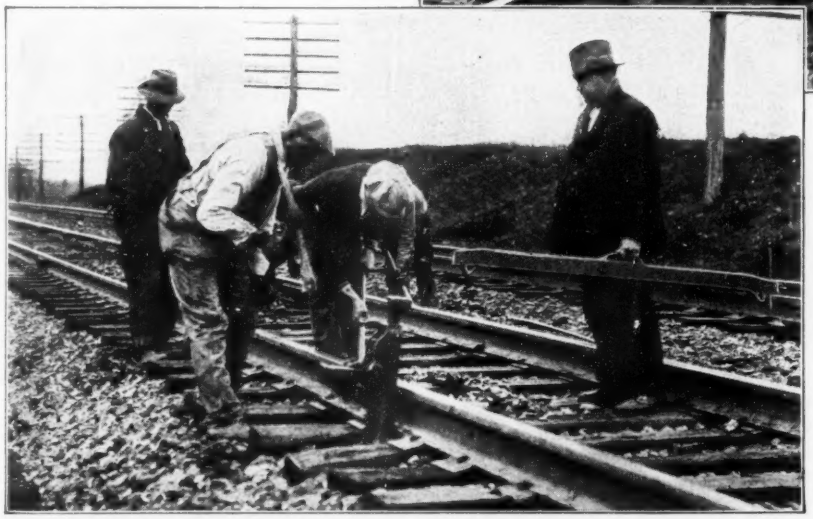
and thrown back to the true alignment. As a curve can be elevated theoretically correct for only one rate of speed, care must be taken to make that the most suitable for conditions at that particular point. Should the elevation be too great, the center of gravity of the slower moving trains comes too close to the low rail and an excessive portion of the weight of the train is carried on this rail. On the other hand, if there is not sufficient elevation for the speed, the thrust of the train against the outer rail becomes excessive and gives the same feeling to a passenger that one has when riding a "merry-go-round." Either condition gives excessive rail wear and at points on heavier curves in mountainous territories where it is impossible to elevate these curves properly, the life of heavy steel rails is less than a year. By applying a heavy grease or oil to the gage side of the outer or high rail on curves, the frictional wear is greatly reduced and the life of the rail at such points has been greatly extended. Normally, rail should last approximately 10 years in main tracks.

THE maintenance engineer has still another problem—that of providing water for the operation of the locomotives. To do this in many territories in quantities suitable for boiler use is a serious problem. Economies in train operation are made by analyzing water available and installing plants to treat this water so that objectionable foreign substances may be removed before the water is placed in the engine tanks.

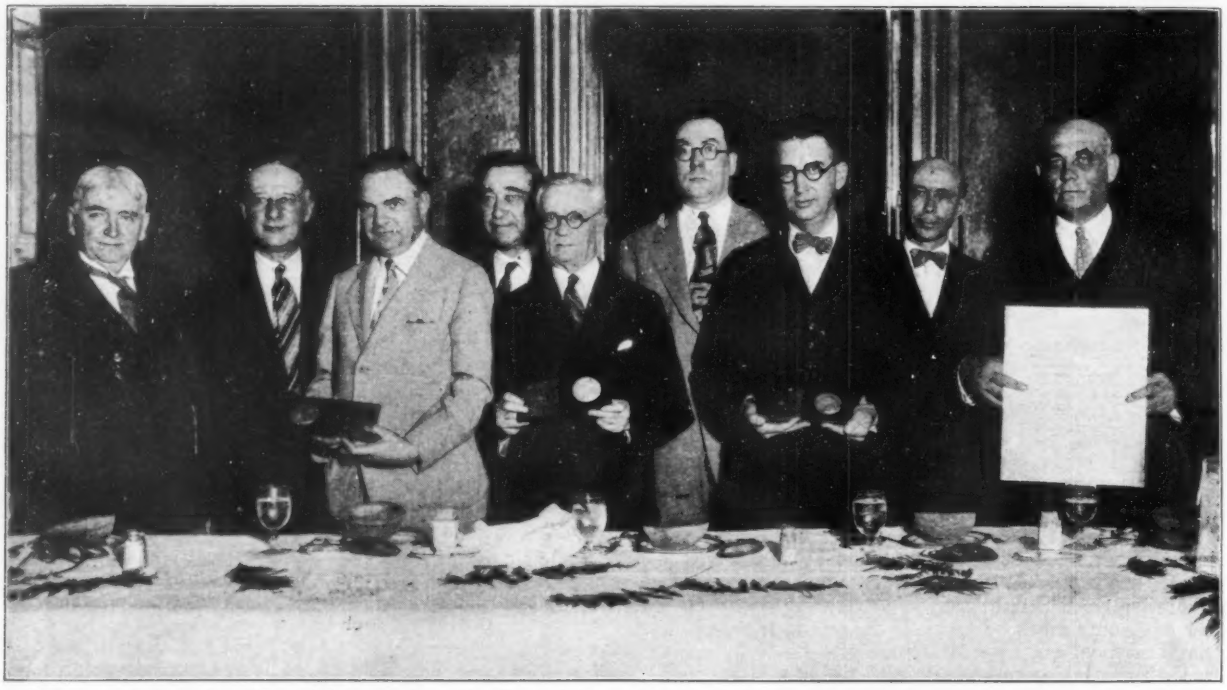
Regular and frequent inspections are made of the tracks and their integral parts to detect any flaws in material or workmanship that may develop into safety hazards. The high standard of materials, workmanship, and inspection that is maintained on the railroads is reflected in the freedom from accidents due to defective tracks and other faults that can be avoided by proper attention to important details. In fact, on one major railroad there have been only 1.5 passengers injured in any manner whatsoever per 1,000,000 passenger miles traveled. On this same railroad there has not been a passenger killed in a train accident in over 10 years.

Bridges, buildings, signals, and other structures form a considerable proportion of the property of a railroad, the construction and maintenance of which call for close attention not only to utility but dignified appearance as well. Safety is the first element of consideration, so that no accident shall occur as a result of failure of these structures. "Safety above everything else" guides here as it does in every phase of railroad activity. All of these facilities, adequately supervised and maintained, provide for rapid and safe transportation. Railroad maintenance is a most fascinating subject because changing conditions never allow problems to remain permanently solved.

Rails are elevated to proper position by hand jacks. The tampers then follow, tamping the ballast under the ties to make a firm foundation



Here the hand tampers are elevating the track slightly where necessary. This leveling prolongs the life of track. The track gage is always in use



Winners of the safety blue ribbon of the rail. From left to right, front: Mr. Arthur Williams, President of the American Museum of Safety; Ex-Governor Alfred E. Smith, Trustee; Mr. H. J. Plumhof, Oregon Short Line Railroad Co., winner of the Harriman Gold Medal; Mr. J. P. O'Brien, Oregon-Washington Railroad and Navigation Co., winner of the Harriman silver medal; Mr. Earl V. Develer, Nevada Northern Railroad, winner of the Harriman bronze medal; Mr. R. H. Allison, Cleveland, Cincinnati, Chicago & St. Louis Railway Co., Honorable Mention, Group C; Mr. H. E. Trout, Conemaugh & Black Lick Railroad Co., Honorable Mention, Switching and Terminal Roads. Rear (left), Mr. J. F. Patterson, representing the Long Island Railroad, Honorable Mention, Group A; Mr. W. G. Curren, Staten Island Rapid Transit Railway Co., Honorable Mention in Group B

The Harriman Medals for Rail Safety

THE late Edward H. Harriman was a pioneer in railroad safety and the good work he started on his own railroad system is now, by reason of the Harriman Memorial Medals, carried on long after his death, Mrs. Harriman giving annually a gold, a silver, and a bronze medal for the railroad making the best records in their respective classes. The gold medal (group A) is given to the winning railroad in the "over 10,000,000 locomotive mile class"; the silver medal (group B) to the winning railroad in the "1,000,000 to 10,000,000 locomotive mile class"; while the bronze medal (group C) goes to the winning railroad in the "less than 1,000,000 locomotive mile class." The railroad in each group having the second best record receives an honorable mention. A fourth group "D" has been added this year to take care of switching and terminal railroads, by means of a proper certificate.

THE growth of safety on our railroads is most gratifying and the Harriman Memorial Medals furnish a great stimulus to renewed endeavor. The award is based on the records of the Interstate Commerce Commission, interpreted by the aid of carefully worked out formulae. In 1929, 157 Class I railroads carried 148,379,000 passengers a total of over eight billion passenger-miles, without a single passenger fatality. Deducing an analogy from these figures, one passenger, traveling continuously at a speed of 50 miles an hour for 183 years, could travel 32,000 times around the earth without accidental death.

The medals were awarded at a luncheon on June 24th given by Mr. Arthur Williams, President of the American Museum of Safety, that makes the awards. A very distinguished company of railway men attended. Ex-Governor Alfred E. Smith, a trustee of the Museum, made the presentations. The Committee of Award is as follows: Arthur Williams, Chairman; Samuel O. Dunn, Editor, *Railway Age;* Charles M. Schwab; Hon. Frank McManamy, Chairman Interstate Commerce Commission; Lew R. Palmer, Secretary; F. D. Underwood; and A. A. Hopkins, member of the staff of the SCIENTIFIC AMERICAN and Director of the Museum.

The Harriman Memorial Medals are awarded for safety on railroads

OUR POINT OF VIEW

Machinery and Unemployment

THE blame for unemployment has always been placed, more or less, upon machinery and, in times past, labor has fought its introduction into industries where handwork had been the rule. Even at the present time, there are numbers of pessimists who deprecate the increasing use of machinery and lugubriously point out that it is a Frankenstein monster. Their memory is short; they have been told time and again of the wage earner's gain through machinery, but they seem never to learn. Thus it is necessary to repeat.

Machinery made it possible for one man to do, in 1925, what 3.1 men did in 1914. Thirty years ago, 200 unskilled workers were required to do the work now performed by one steam shovel. In the glass industry, one machine takes the place of 600 skilled glass blowers of a few years ago. In 1920, there was perfected an automatic machine for producing electric light bulbs, that displaced 994 men; and recently this machine has been so improved that it now displaces something like 2000 men. Many other cases are as strikingly significant.

From these figures, it would seem that the pessimists' assumptions are correct. They're not. The number of wage-earners increased 3 percent during the eight years between 1919 and 1927, but—and this is far more important—our production increased 50 percent! With increased industrial prosperity, better wages have been possible and at the same time the worker has been freed from the bondage of labor. Working hours have been cut down: first from a 12-hour day to a 10-hour day, then down to eight hours, and now proposals have been made to make a further cut to six hours. The workingman's week was cut down from six to five and a half days, and it is now proposed to cut it to five.

Better pay and more leisure in which to enjoy the fruits of his work—these are the dividends of the American wage-earner. There is bound to be some temporary unemployment caused by machinery, but this is in an unimportant proportion to the benefits accruing. Nevertheless, certain adjustments are necessary, and it is up to the workingman himself, as well as to industry, to study the question thoroughly so that, as more and more machinery is put into operation, these adjustments may be made with the least loss and an economic balance may be reached.

Sir Arthur Conan Doyle

AFTER an illness of two months, Sir Arthur Conan Doyle died of heart trouble at his home in Sussex, England, on July 7. Famous throughout the world as the creator of that super-detective of fiction, Sherlock Holmes, he was in late years a diligent student and an ardent believer in spiritism. Considering this as a sort of religion, as "infinitely more important than literature, art, politics, or, in fact, anything else in the world," he was annoyed that he was known chiefly for his creation of Sherlock Holmes, and grieved because his friends did not share his unfaltering belief in the spirit world.

Sir Arthur was interested in writing from earliest childhood, having written his first book at the age of six and achieved fame as a story-teller among his early school-mates. His later education was in medicine and he was a practicing physician for several years. His first recognition as an author came when he wrote "Micah Clarke," in 1888, a year after his first volume of Sherlock Holmes; and he won his knighthood with his apologia for the Boer War. The loss of his eldest son in the World War was largely responsible for his devotion to spiritism during his later years.

Sir Arthur was for many years a reader of SCIENTIFIC AMERICAN; and while our opinion relative to psychic, or spiritistic, phenomena, differed from his, we always counted him one of our firmest friends. It may be supposed that the untrammeled imagination which created the greatest detective of fiction "created" much of the spirit world of which he has been called a sort of "Bishop," but that may be countered with the argument that perhaps the practical, analytical mind that worked out Sherlock's crime solutions discovered truths still unknown to many of us. As yet we are not ready to admit either; we are open-minded.

All But the Rattle

EARLY this year it was announced that certain automobile manufacturers would, during 1930, junk old cars up to a value of around 15,000,000 dollars. It was explained that this procedure would have several benefits. First of all the removal of derelicts, still on wheels and a menace to other cars on the road, would prove a blessing to motorists. Manufacturers also said that these rattle-traps undermined their replacement market and their removal would measurably increase sales—a mere matter of 15,000,000 dollars being small compared to the expected sales of 4,000,000 cars at around 3,500,000,000 dollars. Then, too, junking by the manufacturers would decrease the number of old cars that are yearly abandoned along roads to become eye-sores. The plan was heralded as one of the shrewdest moves the automobile industry had ever undertaken.

In the SCIENTIFIC AMERICAN Digest of this issue, our readers are given the first story of how this junking is done. In the Ford plant, the process turns out to be a salvage job in which, with characteristic thoroughness, Henry Ford saves all but the rattle of derelict cars. And although it is said that the salvage per car is 14 dollars, our opinion is that it is more, that the Ford company actually makes money on the proposition.

Other manufacturers no doubt are junking many cars also, but so far we have no details. Those who are not would do well to follow their lead for, aside from all other considerations, the job of salvaging metal in this wasteful country is well worth while and may in time be a vital necessity.

International Affairs

THE INTERNATIONAL BANK

THE beginning of the Bank of England during the reign of William III was modest indeed, and the most far-seeing financial genius of that era could not have predicted its future or imagined the tremendous effect it would have on England's and the world's commerce. And today as we listen to the advocates and opponents of the International Bank established to facilitate the settlement of war reparations, we suspect that even the brilliant financial leaders that conceived and boldly sponsored this world bank, and the more conservative bankers who sincerely oppose this new venture, could not gather together and jointly form a reasonably adequate conception of its future effects on world trade and world relations.

That it will be a success, granting reasonably proper management, is a foregone conclusion; that it will become a ponderous financial fly-wheel, steadying world trade and stabilizing foreign exchange, seems probable even to financial laymen; that it will become such a prize that its control will gradually become another bone of

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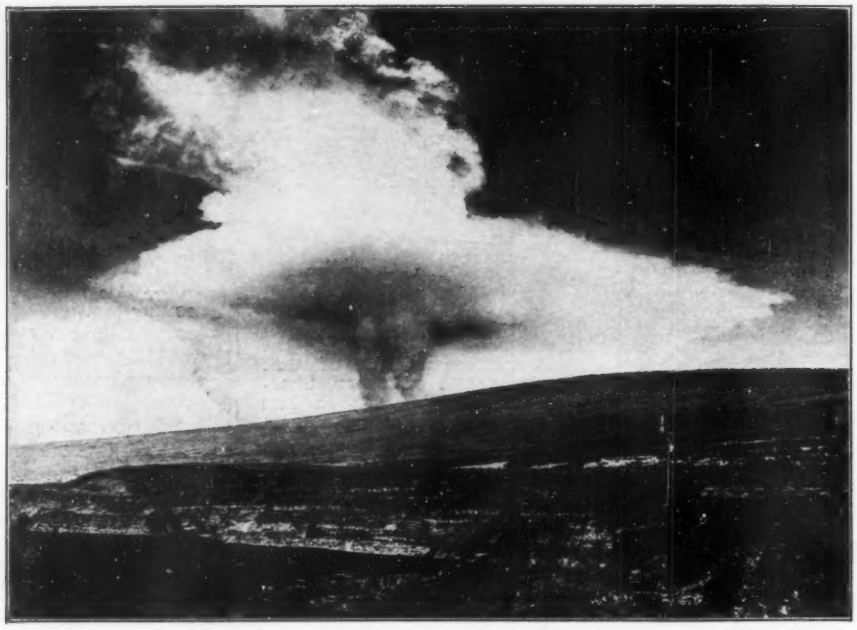


Outburst of Mauna Loa as seen from Kilauea Observatory at 8:30 A.M., May 19, 1916, photographed by Dr. H. O. Wood. This was referred to at the time as the "ballet girl" stage of the eruption. The two legs of the fume column were about two miles apart where the gas rushed up from different places along the southwestern rift of the volcano. A few minutes later they merged into one and the action became stronger. Later the rift opened and gave vent to a lava flow. The distance from the observer is about 25 miles. Kilauea crater in the foreground

Volcanology

What Is Being Done to Make the Observation of the Earth's Internal Fluids an Experimental Science

By T. A. JAGGAR
Volcanologist U. S. Geological Survey

IT may seem strange to many people to learn that the recent campaign suggested by the SCIENTIFIC AMERICAN for interesting amateurs in seismology promises to be of great assistance to volcanology. What is volcanology? A tourist, who recently visited Kilauea Volcano in Hawaii while it was sleeping, expressed the popular viewpoint. He saw the observatory and learned of the existence of a volcanologist. "What a cinch," he remarked, "nothing to do but wait for an eruption!"

It had never occurred to him that some of the fundamental processes of volcanology are happening under Iowa at his home town. It had never occurred to him that possibly the recent Mississippi flood with its losses of three hundred millions of dollars is not unrelated to the forces that made the New Madrid earthquake in 1812. The science of the earth is all one thing whereby the continents rise, erosion carves out the valleys, sedimentation fills the mediterranean seas (of which the Gulf of Mexico is one), and the sea bottoms lower. There is a shift of matter under or within the crust of the earth from the heavier regions to the lighter. There is every reason to suppose that this matter is magma, which makes the intrusive rocks at the core of our mountain ranges, or the lavas which pour out at volcanoes.

VOLCANOLOGY is concerned with the movement of magma. This movement is going on all the time somewhere, rapidly in some places, slowly in other places. It is probably much more important to mankind in its buried movements underground than in its visible movements at volcanoes. These buried movements and shifts of magma lift the mountain ranges at the sources of the Mississippi, lift shore lines in California and Japan, are somehow concerned with the scorching heat under the steam power plant at Geyserville north of San Francisco, and the high temperatures of our deep oil wells, and play their part in the stresses that make big earthquakes.

Science is gradually learning that what is happening under your home town in Montana or Pennsylvania or Louisiana, at a depth of about 35 miles, is equally important with what is happening in the air 30 miles above you. The aviators and the radio people need all possible knowledge of the air. The geologists need all possible knowledge of the earth and the relations of its gases, pastes, and solids. We explore the air with balloons and radiation. The oil people are beginning to explore the earth with echoes, conductivities, magnetic needles, and torsion balances. Volcanology needs the assistance of amateurs to microscope the tiltings and tremblings of vast continents, because without them the job appears to be too big, even for the government.

This makes volcanology something very different from what you thought. Nevertheless, the study of volcanoes and volcanic eruptions is a part of the game. For volcanoes have the advantage that they lie over places where the earth crust is thin, where the ground is hot close to the surface, and where the lava may sometimes actually be seen emerging. In a general way all the active volcanoes of the present day lie at places where there was much greater volcanic activity in

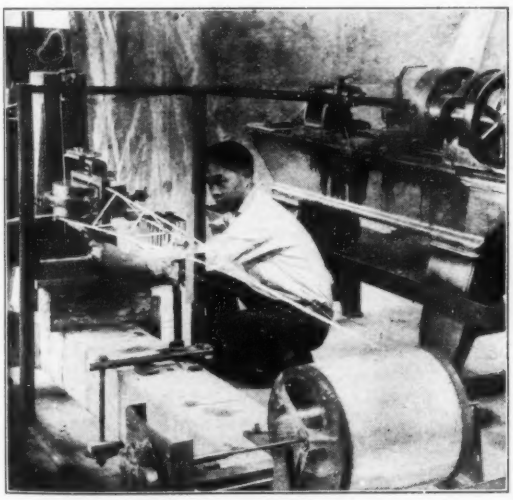
Tertiary time. That is, there are more extinct volcanoes at the volcanic districts of the world than there are live ones. Volcanism today is decadent. In the economy of the earth there have been geologic ages representing big cycles when the crust heated up and cracked, and volcanic magma poured out. The Miocene Tertiary was the last of these.

Decadent volcanism, however, in a volcano belt does not necessarily imply decadent magma underground. The magma underneath a chain of volcanoes may be engaged in processes of intrusion at the present age in a fashion much more lively than that which underlies Iowa and Pennsylvania. If we can make our instruments sensitive enough to show the same kind of motion under both Hawaii and Pennsylvania, but quantitatively greater in Hawaii, we are creating a science of volcanology wherein nobody has to wait for "eruptions." The popular conception of an eruption as something violent, steamy, and explosive is based on a very occasional happening at volcanoes, not at all characteristic of that flow of magma which has done most of the building of the great volcanic lands of the world. Volcanoes show us magma flowing out as lava, and a sensitive pendulum set up on a volcano shows us the ground tilting and trembling as a result of the magma spreading underground as an intrusive, or escaping elsewhere as an outflow. This is what makes a volcano so valuable as a natural laboratory. If we may correlate the physics of the ground with visible flow of magma, we may then go elsewhere and interpret underground flow of magma from measurements of the physics of the ground.

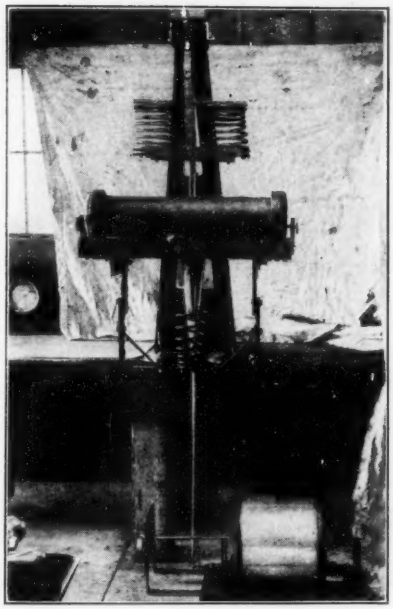
THE original study of volcanoes began with human necessities. Bad eruptions happened at Vesuvius, and the meteorological observatory there turned its scientific work in the direction of keeping a journal of what the volcano was doing. A bad earthquake happened at Naples, and Mallet made some interesting studies of how the buildings were thrown down in relation to a supposed center of bumping underground. The buildings were cracked at right angles to lines extended out in all directions from the center of the shock. If this theory worked, then a building right over the earthquake center, or at the epicenter, ought to be jolted straight up and down, and cracked horizontally. A building far away to the east of a shallow center should be broken vertically along north and south cracks.

If earth movements were as simple as this, the study of earthquake sources would soon become an open book. It was originally thought that steam explosions and collapses underground accounted for earthquakes near volcanoes. Then it was argued that these things are very small, and that volcanic earthquakes are very small. When a very big earthquake happened, like that at Messina, near Mount Etna, it was argued that this could have nothing to do with the volcano, because the volcano did not erupt at the same time. Geological text books have rung the changes on this argument, distinguishing between tectonic and volcanic earthquakes. Tectonic earthquakes are supposed to be crustal movements that have nothing to do with magma, but are occasioned by expansion or contraction or pressure such as are involved in the world forces which build mountain folds and faults in strata. The modern volcanologic viewpoint is that earthquakes occurring at an active volcano may be large or small, shallow or deep, usually occur at faults and not at craters, and represent forces which may be either tectonic or magmatic, according to the way in which those terms are defined. As we have magmatic movements of intrusion and continental balance under the mountains, and as we have crustal movements of pressure, expansion, and contraction under the volcanoes, and as nobody knows what makes an earthquake anyway, the guess of every amateur seismologist is just as good as the next man's.

Between 1891 and 1923 there grew up in Japan a science of field seismology led by Dr. F. Omori. Japan is a land of earthquakes and volcanoes mixed together. Dr. Omori devoted himself at first to devising seismographs and spreading them among the meteorological stations of Japan. He measured thousands of earthquakes. Very ex-



Shaking table with horizontal pendulum seismograph mounted on it, at the Hawaiian Volcano Observatory. This machine is to make artificial horizontal earthquakes with the aid of a lathe chuck. The connecting rod at the lathe has its motion reduced at the two upright levers which rotate on the floor, two steel rollers under the table containing the seismograph. Any quick period required may be given to the apparatus by means of the lathe gears, and the amplitude is made to imitate local earthquakes. A series of tests compares the actual and theoretical magnification of the seismograph as recorded by the pen writing on smoked paper on the drum. Both drum and pendulum are attached to the shaking table. In this way seismographs made in the shop may be calibrated artificially in order to learn how they will behave under earthquake impulses. The shaking table was designed by the geodesist R. M. Wilson



An experimental seismograph built in the shop of the Hawaiian Volcano Observatory, on designs by the author, for registration of the vertical motion of local earthquakes. The heavy mass weighs 160 pounds and is supported by spiral springs designed for compensation of temperature effects. The registration apparatus is the long, aluminum arm protruding downward, here not shown in its proper relation to the writing pen on the chronograph drum. In operation, the drum is coated with smoked paper and makes one revolution in 30 minutes. When properly placed, the tip of the boom connects with the short arm of the stylus, the pier is mounted on a concrete table in a quiet cellar, and a time-marking apparatus lifts the pen tip once a minute, while the chronograph drum moves along on its spindle. The action of the earth lifts the pier at a horizontal hinge line around the heavy mass acting as a center of percussion

ceptional earthquakes were accompanied by big fault cracks, the sides of which moved up or down or sideways. Geologists have the habit of pouncing joyfully on these exceptional ones and concluding that the accumulated stress in the rock at the side of the fault crack was released when the fault gave way and that this yielding to accumulated stress is the usual cause of great earthquakes. Oldham, a distinguished geologist of India, has combated this notion with the argument that the stress is developed very suddenly in the deep region. Omari found out that earthquakes are far from simple, that big ones may occur in the midst of a big volcanic eruption, or near a big volcano not in eruption, or in a district not recently volcanic at all, and that some of these earthquakes have obvious fault movements and that some show no obvious faults at all.

THIS last fact had been observed by Oldham in India, by the Americans at the New Madrid earthquake of 1812, and by Major Dutton at the Charleston earthquake of 1886. Omori came more and more during the last fifteen years of his life to devote himself to the study of volcanoes, for he saw that there is an infinite series of earthquakes, small to great, somehow related to magma. He and his successors have learned in Japan that both volcanic eruptions and strong earthquakes are accompanied by topographic changes of elevation of the land. In using the expression "volcanic eruption," in this sense, the reader should remember that flow of magma is meant. A big gush of explosion with ash and steam is not essential to a volcanic eruption, and a retirement of lava straight downward under a volcano crater might be accompanied by a very important "eruption" or flow of magma. In this case the eruption would be a flow of lava from a rift under the sea which nobody would notice, unless the volcanologists were using their wits. And seven tenths of the geology of the earth is under the sea.

In 1911 an observatory was started at Kilauea Volcano in Hawaii, which the writer has had the honor to operate. This also was influenced by the humane viewpoint, for the terrible disasters at St. Pierre, Vesuvius, Jamaica, Messina, Etna, and Costa Rica had induced donors to create an endowment in the Massachusetts Institute of Technology for geophysical study that might lead to amelioration of conditions in earthquake lands. The observatory was started by the Massachusetts Institute and carried on thereafter by the Hawaiian Volcano Research Association assisted by the government. The Hawaiian Volcano Observatory kept a diary of everything that happened at the Hawaiian volcanoes and measured everything that was measurable within the limit of funds at its command. The volcanoes were mapped, the Kilauea lava pit was mapped again and again as its lava topography changed, leveling circuits were occupied repeatedly, a seismograph station was set up at the crater and afterwards supplemented with other stations about the island, and experiments were inaugurated.

Southeastern corner of the lava lake of Kilauea, March 19, 1921, at 2 P.M. A cauldron sink-hole against the pressure ridge at the edge of the pit had formed, and the lava was rushing toward this place and being sucked down in the convectional circulation. Single jets of lava shot up by the escaping gas were 40 feet high. The torrent on the right is rushing into the cauldron, and a rampart is being built up in the background. This was a crisis of high rising when the fire-pit overflowed and the gas pressure was enormous. Photo by the author

THE experiments proved, by the use of different kinds of thermometers and pyrometers, that the liquid lava grows hotter from below upward, just as it grows more foamy from below upward, as the bubbling gases are released from solution in the melt beneath. This melt is very dense under pressure down deep, and as the gases escape to the bubble form under release of pressure, they react with each other and with air to produce combustion of hydrogen, carbon monoxide, and sulfur gases along with rise of temperature. A lava eruption is thus a heating expansion of slag foam. This was a new idea. When this basaltic foam spreads out in the crater or beyond, in contact with atmospheric temperatures, it freezes, and in the crater pits it is engaged in an incessant struggle with congealing cold.

The topography of the top of the live lava column in Kilauea Crater becomes diversified into crags, floors, and lakes of lava. A series of experiments with steel pipes was initiated whereby it appeared that the liquid lakes are only 40 or 50 feet deep, with wells and tunnels feeding them. These wells and tunnels are not in the solid rock of the mountain, but form a honeycomb in the partially hardened lava that underlies the crags and floors. This hardened lava column is red hot and pasty, with tubes leading up through it to the shallow saucers of foamy lava on its top, while somewhere down deep both the pasty lava and the liquid merge into the very stiff primitive rising lava, under great pressure, and with the gases in complete solution.

THIS primitive stuff nobody has ever seen. When it is released from pressure to froth into the region of man's ken, it changes, heats, gassifies, and oxidizes to a glassy foam mixed with burning gas which may be very unlike the mother magma. The partially congealed refuse of this makes the lake bottoms, crags, and floors, and this paste rises and falls majestically as the main lava column in the pit, with the liquid lakes rising and falling at about the same rate on top of it, but with small differences between the two from day to day. The discovery of the difference between bench lava and liquid lava was another new idea.

With all this rising and falling, measurable with reference to the bench marks on the edge of the crater, it became of interest after 15 years of work to see how the curve of up and down compares with past curves. It was well known from the work of the devoted missionary Coan in the middle of the 19th Century, that Mauna Loa had more than a dozen outpourings of lava in great streams sometimes 60 miles long, and that Kilauea had lava in its pit most of the time. There had been some hint of a cycle about nine years long. The Hawaiian Volcano Observatory uncovered a cycle between 1913 and 1924, eleven years long, with the pit very deep and inactive at both ends of this time. Moreover, the lava rose from 1913 to 1919, sank from 1919 to 1924, and crashed down with a great engulfment of the walls of the pit in the last named year. Along with this

culmination of 1919, Mauna Loa showed increasing eruptions in sympathy with the Kilauea cycle. The 11-year period was compared with what is known of the 19th Century, and it was discovered that the high levels agree very well with years of maximum sunspots, and that 12 cycles of 11.1 years each from 1790 to 1924 agree better with the facts than the older conception of a nine-year cycle. It happens, too, that this is just the sunspot average.

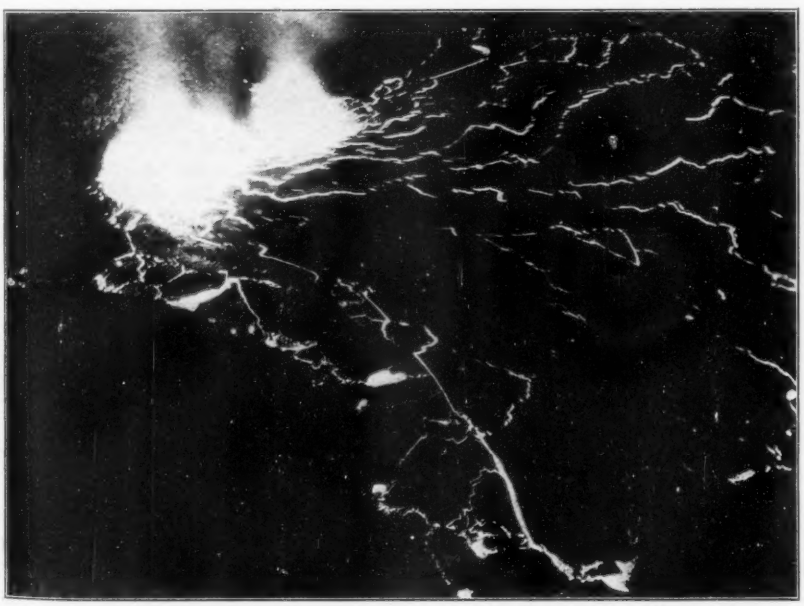
THE facts indicate that Mauna Loa and Kilauea alternate somewhat, and that there is a greater cycle 134 years long during which the lava of the entire Hawaiian system rose to a culmination of outpouring about 1855, declining thereafter until 1924, when there was an explosive eruption at Kilauea, and very probably a submarine lava flow under the deep sea off to the east. The supercycle had followed an explosive eruption at Kilauea in 1790, and this larger interval of something like 130 years corresponds to similar periods in Japan and Italy elapsing between great earthquakes or great volcanic eruptions at the same place. It is reasonable that magma should move in waves of accumulated gas pressure and release, and also there may be astronomical controls in these cycles.

The volcano seismographs at Kilauea have indicated thousands of earthquakes, and by comparing the records with those of the secondary stations and with the reports of felt earthquakes at habitations, it has been possible to locate groups of earthquake centers. These have often corresponded fairly well with known volcanic fissures or faults, sometimes when the fissures in question broke into eruption and gave vent to lava flows. The earthquake centers rarely correspond with summit craters. Often the earthquakes, registered by a pendulum and a pen writing on smoked paper, are accompanied by a swinging off of the pendulum to a new position after the earthquake. This means that the ground has tilted during the earthquake. These tilting movements have been compared with changes of level of the country as proved by geodetic levelings. It has been discovered that Kilauea Mountain rose more than two feet while the lava was rising in the seven years following 1913, and sank by a similar amount during the explosive engulfment of 1924. And the pendulums indicated the actual months of maximum tilting, as corresponding with times of maximum lava pressure and lava withdrawal.

All of this means that land underlaid by magma is subject to swelling and shrinking forces, and it will prove increasingly fascinating to harness these forces with simple instruments and volunteer observers until the centers of motion, and the relative motions of different places, have been discovered. To anyone who has worked where these motions are rapid and strong, as on Hawaii, it appears that the geographical facts of distribution of motion, in relation to volcanic centers, are much more needed than precision work at one place. That is where the amateur and volunteer will come in, and consequently the simplification of instruments appears to the writer to be the most important need of seismology.

What is the use of volcanology? On the answer to this depends in part how we ought to attack the science. If we are interested in theories of the earth's internal elasticity, of its heat, of its gases and radioactivity, and care nothing for the effects of volcanic eruptions and earthquakes on mankind and his cities, we should devote ourselves wholly to precision laboratories with only minor attention to geography. But there comes into the argument the Mississippi flood, the devastating tidal waves, the failure of gigantic engineering works at times of great earthquakes, and destruction of cities such as St. Pierre. If a great insurance company were to create a research laboratory of volcanology to solve company problems, what would they demand? They would certainly demand, first, attention to engineering and to geography. In other words, the human need for a science of eruption, of deformation, of sedimentation, and of erosion calls for field laboratories eternally measuring by observatory methods the quantitative aspects of those processes. All the processes are tied together as affecting the pipe lines, dams, railways, farms, cities, roads, bridges, wharves, levees, aqueducts, wires, harbors, and fills on which human beings have spent billions of dollars.

AS it is, the science of volcanology, quite apart from volcanoes, is the forerunner of a new science of the earth, which at this moment in America is being greatly assisted by the new flood-relief measures carried out by the government on a gigantic scale on all the rivers of the United States. Probably few people realize that this study of earth process is the pioneer of a science of geonomy, the workers of which will be geonomers living at observatories and actuated by the same spirit as astronomers. Erosion science has hardly been touched, yet mountain canyons are falling down all the time and their wreckage is being swept to the ocean. It is a marvelous opportunity for new measurements and new instruments. Mountains are heaving up, continents are tilting, flood plains are shifting, waters are muddying and clearing, bays and lakes are filling, the bedrock is shaking and, under all, the magma is welling under the crust of the earth, warming the hot springs, heaving the hills, and accounting for a hundred unmeasured phenomena up and down the Pacific Coast and Alaska, as well as in Arkansas, Virginia, and the Adirondacks. With simplified instruments and hundreds of amateurs, we may expect the natural history of the earth to take a new lease on life.



Night photograph of a live lava lake in the bottom of Halemaumau pit at Kilauea Volcano, July 25, 1929, at 9 P.M. It shows the bright lines on the surface of a crusted pool of lava, and the great luminosity of fountains flaming during an eruption in which a fountaining lava grotto similar to the one on the front cover furnished the molten matter which sweeps over the pool

Why Stars Twinkle

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

PROBABLY the first thing that many of us learned about the stars was that they twinkle, and the fact is obvious enough to deserve its place in the nursery classic. But does any grown-up, except perhaps an occasional minor poet, notice the phenomenon—and in particular what have the astronomers to say about it?

As a matter of fact the professional observer habitually scans the twinkling lights of heaven as he walks toward his telescope and the more they twinkle the less is he pleased. Whenever the brightest stars, though low down in the sky, twinkle but lazily and those higher up shine steadily, he anticipates a good night's work. But on our clear snappy winter nights, when the wind roars overhead and the brilliant stars are dancing and flickering, he hopes for little or nothing; and after one glance through his telescope he may even shut up shop and go home to bed.

For the twinkling of the stars is the best test that the unaided eye can make of what is technically called the "seeing"—that is, of the state of the air through which we must look. The late Professor Young, translating literally and with his characteristic jocular humor from some French book, used to repeat to his students, "The earth's atmosphere is the astronomer's black beast" and a *bete noire* it surely is.

FORGET for a moment the clouds, fogs, smoke, and rain which so often blot out the heavens altogether and think of the limitations which even clear skies impose. Could we astronomers but live without breathing, and escape for our working time to an airless world, our lot as observers would be a happy one. With nothing above us to scatter the sunlight and veil the heavens with blue sky, we could see the stars as well by day as by night—and photograph them too. The solar corona could be observed at any time merely by hiding the sun's disk by a suitable screen placed in front of our telescope, instead of waiting years for a total eclipse. Best of all, our spectroscopes could get at the far ultraviolet parts of the spectrum of the sun and stars, which is utterly and hopelessly cut off by the absorption of light of this sort in the upper atmosphere and which probably contains more things of astrophysical interest than all the parts that we actually can observe.

But let all this pass again and write it off as hopeless, even to dream of. Even so, the cloudless sky still is too often our worst enemy. The atmosphere is lamentably far from being optically satisfactory to look through. It refracts light, which would not be a serious matter if it were only homogeneous—but this it never is. The air is full of streaks and patches of different temperature and unequal densities, which are carried along by the wind and churned into a still more turbulent complexity wherever the wind is puffy or where winds blow in different directions at different levels. Large scale disturbances of this sort are often directly visible as dust whirls near the ground, or as the long parallel streaks of cloud in the "mackerel sky." They are all too familiar to the airman, too, as the "bumps" which make flying uncomfortable and occasionally even dangerous.

THESE larger irregularities are not always present, fortunately for the astronomer, but the smaller ones are always there and make trouble enough. Looking through them is, on a smaller scale, like looking up through running water or the rippled surface of a pool. Every streak of denser or thinner air, like the crest or trough of a ripple, acts as a lens would do to concentrate or spread out two originally parallel rays of a star's light. If only the starlight was strong enough, said Young many years ago, we should see on a white surface illuminated by it a moving pattern of lighter and darker patches resembling that formed on the sandy bottom of a pond when the sun shines on its rippled surface.

This prediction can be verified by anyone with keen eyesight who takes the trouble to find a dark room with a window free from all disturbance from artificial lights and let the light of Sirius come through the window (stopped down to a couple of feet square) and fall on a white sheet a dozen or more feet away. Until his eyes are fully adapted to the pitchy darkness, which will take 15 minutes or more, he will see very little. But then he will find that the patch of starlight on the screen is distinctly visible, even for considerably fainter stars, while for Sirius it is bright enough to exhibit the shifting lights and darker patches which Young predicted. Now imagine an observer looking through a hole in this screen. As the brighter or fainter patches pass over it he will see the star increase or diminish in brightness. In other words it will *twinkle* and of course it will do so just the same if the screen is not there.

We see now, not only why the stars twinkle, but why their twinkling gives really valuable information to the astronomer regarding the state of the air—much better, indeed, than could be obtained by looking, even with the sharpest eyes, at a screen illuminated only by the feeble light of Sirius. It is clear, too, why stars high in the sky twinkle less than those lower down, for the rays of the first traverse a smaller thickness of air and so pick up less trouble.

Why bright stars seem to twinkle more than faint ones is not so obvious, the explanation being that rapid changes in the fainter object are less conspicuous to the eye than in the brighter one.

NO explanation is needed why the stars twinkle more on a windy night than on a calm one. Indeed, when they twinkle violently on a night when there is a calm or a light breeze at the ground it is very probable that it is blowing half a gale higher up.

It is obvious, too, why terrestrial lights usually twinkle when seen at a distance of some miles, especially when seen through a wind or across ground from which heated air is rising, or from the deck of a moving steamer—as the writer has this moment seen the lights of a Greek seaport, twinkling furiously.

The planets do not twinkle, at least under any ordinary circumstances—which affords one of the simplest rough-and-ready tests by which the novice may distinguish them from the stars. The reason again is simple. The planets, unlike the stars, show disks of considerable angular diameter. The lines along which light enters our eye from different parts of the planet diverge when followed backward. The rays from opposite sides of Jupiter, for example, which enter the same eye were more than a foot apart a mile farther back on their course. If we could isolate the light from any one

small portion of the planet it doubtless would twinkle, but the different parts do not keep step in their twinkling and so the whole amount of light received by the eye does not change perceptibly. That this is the true explanation is shown by certain exceptions which prove the rule. Mercury, which shows a small disk, often twinkles, and so may the larger planets when seen near the horizon through turbulent air.

A star, when it twinkles, changes not merely its brightness but its color, especially if it is at a low altitude. How great these changes are is not generally realized because they usually happen too fast for the eye to follow. A simple device reveals them. Look at the star with an ordinary field glass and swing the glass rapidly with a sort of conical motion (a thing easier to do than to describe in a few words) so that the star appears to follow a rough circle within the field of view. If the motion is fast enough the luminous point will appear to be drawn out by the persistence of vision into a curving line of light. A star which is not twinkling gives a uniform line but one which is, shows a surprising variation both in the intensity and color of the light. On a night of bad seeing the luminous line is beaded with patches of brilliant color, almost like the flashes from a diamond. When the glass is held still the successive changes, which may follow one another 20 times a second or more, become partially though not wholly fused into the familiar flickering image.

THIS remarkable and beautiful phenomenon was first explained by the Belgian, Montigny, more than 70 years ago, but it still is not as widely understood as it ought to be, and the writer owes the account which follows to the excellent Italian treatise of Professor Armelline of the University of Rome.

Owing to the refraction of light in the atmosphere the rays of starlight which traverse it are not quite straight, but are curved slightly downward as they go deeper. Blue and violet light are refracted more than red and yellow, so that the corresponding rays are more curved. If, then, we have a streak of air high up which, for example, acts as a convex lens, the red and blue rays, though both concentrated into bright patches of starlight on the earth's surface, will pursue paths of slightly different curvature and will not reach the earth in the same spot. If, then, we could see the patterns cast on the surface by the red and blue light separately, we would find them very similar in design but shifted laterally with respect to one another.

FOR a star in the zenith, indeed, the rays would come down straight and there would be no shift, but in all the cases the red and blue patterns would be out of register by an amount increasing as the star's altitude diminished; and also of course the higher in the air were the regions which produced the pattern. The actual light pattern would be very complex, composed of patterns of all colors, some more out of register than others. But it is evident that, from point to point in it, any given color might happen to be intensified, and any other (not too nearly like the first) might be weakened. The resulting pattern would therefore be irregularly and sometimes strongly colored and as it drifted past an observer's eye the star would appear to change in color as well as in brightness. There can be no doubt that this is the true explanation. It is confirmed by the fact that conspicuous changes of color appear only in stars at a low altitude, for which the curvature of the rays is greatest.

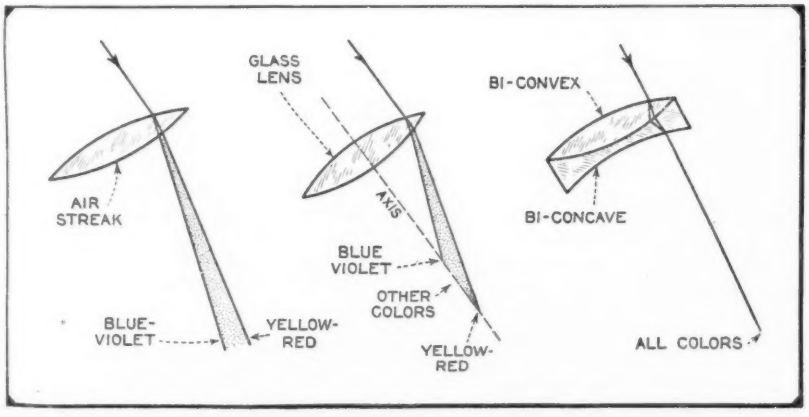
When viewed with a telescope, especially a large one, the appearance of a twinkling star differs greatly from that which it presents to the eye. The changes in brightness and color are far less conspicuous, but the star images at times of modest disturbance appear to shift and dance irregularly about. When the seeing is really bad the image is distorted and refuses to come to any sharp focus, but is continually "boiling" and shifting; and sometimes it "explodes" into a diffused mass of considerable size.

All these effects again are readily intelligible. The rays which strike different parts of the objective of the telescope and are brought by it to one focus have traversed different paths within the atmosphere, so that some of them may be weakened at any given moment and others strengthened. The changes in brightness of the integrated image are therefore pretty well ironed out, and the same is true of the color.

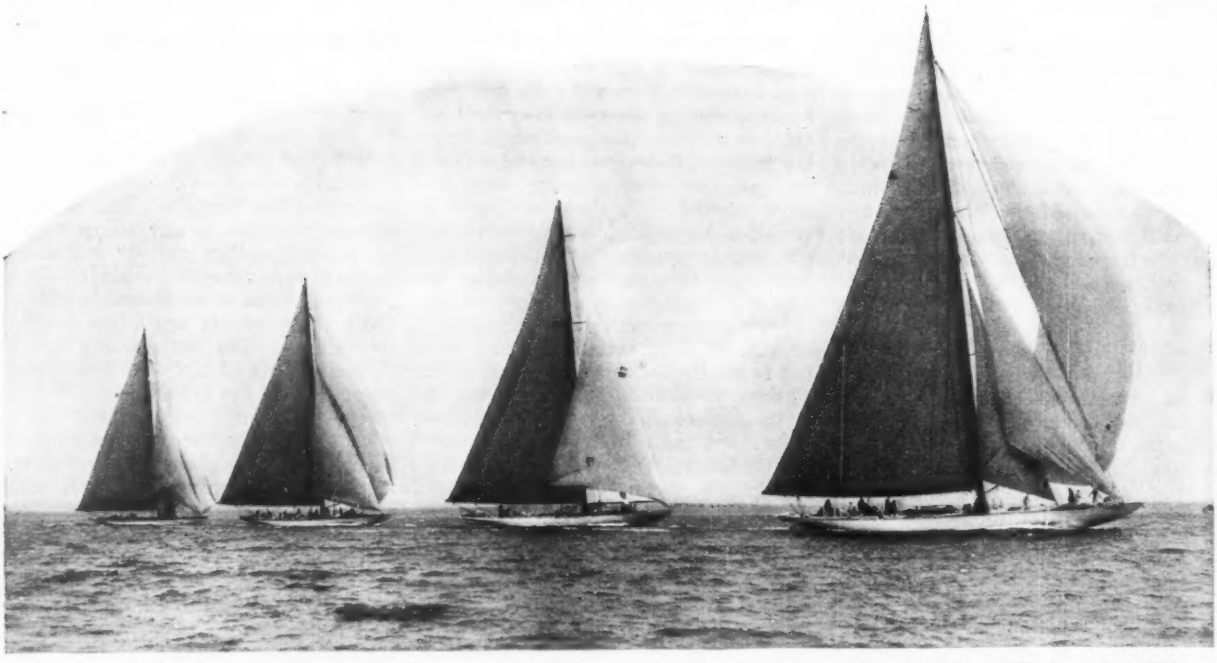
On the other hand the small lateral deflections of the direction of the ray as a whole, which are usually quite imperceptible through the unaided eye, become visible and often conspicuous when magnified. When the disturbance pattern in the air is on a large scale all the rays which enter the objective of the telescope may be deviated in the same general direction, and as this changes from moment to moment the image dances. When the pattern is small the rays entering different parts of the objective are deviated in different ways and the image refuses to come to any good focus but boils, and in particularly bad moments it explodes. This sort of trouble evidently should be most frequent with large telescopes, and so it actually is found to be.

ATMOSPHERIC disturbances of all these kinds are among the worst defects that can afflict an observing station. It is no wonder then that when a great observatory is being planned careful tests of seeing are made at many proposed sights and often enough to get a good average representative of conditions the year around. For work of this importance a telescope of several inches aperture in the hands of an experienced observer is necessary. But in the preliminary reconnaissance which selects the places for further testing the simple observation with the naked eye of the twinkling of the stars should suffice to exclude many hopeless situations and pick those which are more promising.

So the modern astronomer who sees the little stars twinkling—and the brighter ones still more—moves on, fearing that, should he set up his telescope in so ill-favored a spot, he might find it useless for the greater part of the time, and be left "wondering" what the stars "are," rather than finding out.—*In the Gulf of Corinth.*



A streak of denser air high aloft (see left hand sketch, which is of couse diagrammatic) affects the light rays arriving from space in the same way as a simple bi-convex, non-achromatic lens (middle sketch). In the case of the glass lens we can virtually balance out this "chromatic aberration" by adding a second lens (third sketch), but there is no convenient way of capping a dense air streak with a rarefied one, even from an airplane, and this is why the astronomer often must "go home to bed," as Dr. Russell says in the text



The candidates for the defence of the America's Cup. *Right to left: Weetamoe* (1); *Enterprise* (4); *Yankee* (2); and *Whirlwind* (3). The defender will be selected in the latter part of August after a series of official trial races

The America's Cup Defenders

By HERBERT L. STONE

Editor, *Yachting*

WHEN the little schooner yacht *America* fared forth across the Atlantic 79 years ago this summer to fling down the gage of defiance to British yachtsmen it is safe to say that not one of the adventurous spirits who backed that valiant effort ever foresaw that the insignificant cup which now bears the name of the vessel that won it would one day stand for the supremacy of speed upon the waters; or that many millions of dollars would be spent in any single attempt to retain it in this country.

For 79 years, during which 13 hard-fought races, or matches, have been sailed for this particular bit of silverware, the cup has never left our shores; and to meet Sir Thomas Lipton's fifth challenge this year we have made, perhaps, the most elaborate preparations for its defence in September that have ever been seen in any yacht race. For we have built no less than four candidates for the defence, the cost of which, together with the expenses of campaigning them throughout the season, will total between three and four million dollars. And this for a cup the intrinsic value of which was originally 100 guineas, or about 500 dollars

The schooner *America*, which was built in New York at the foot of East 12th Street, after a model by George Steers, for a syndicate of New York Yacht Club members headed by Commodore John C. Stevens, was, as far as the records show, the first American yacht to cross the Atlantic for the purpose of racing in a foreign country. It had been suggested that, in connection with a great international exhibition to be held in England in 1851, it would be "eminently fitting" if America send over a yacht to sail in the races to be held in English waters that year. It was also intimated that plenty of matches could be secured in the event of a yacht being sent. So the *America* was built and sailed across in the spring and early summer of that year. She was a schooner of moderate size, being 90 feet long on the water and 101 feet, 9 inches over all, her model following closely that of a smart pilot schooner turned out by George Steers a few years earlier. Her rig was distinctly American, with excessively raking masts, a single big jib, and a loose-footed foresail.

But when the *America* reached British waters she found it exceedingly difficult to arrange for the promised matches. Her crew made the mistake, as she sailed up the Solent towards the Royal Yacht Squadron on her arrival, of tackling the "crack" English cutter *Laverock* in an impromptu brush, during which she beat this boat so handily in a beat to windward that other British yachtsmen seemed loath to sail a race with the stranger. English yachtsmen were most hospitable, but they showed a strong disinclination to arrange a special match with the *America*. Finally, Commodore Stevens, despairing of getting a race, posted a challenge to sail the *America* in a match against any British vessel whatsoever for any sum up to 50,000 dollars. This had no effect in bringing about the desired meeting, but the officers of the Royal Yacht Squadron informed Commodore Stevens that the *America* could race in the regular open regatta of the Squadron on August 22nd, for which all of their yachts were eligible, the race to be sailed without time allowance. The prize was to be a trophy, put up by the Club, valued at one hundred guineas.

This was hardly what the crew of the *America* wanted, but they decided to start, the course being around the Isle of Wight, a distance of about 53 miles. There were 15 starters in this race, all British except the *America*, and ranging in size from 47 tons to 392 tons, the

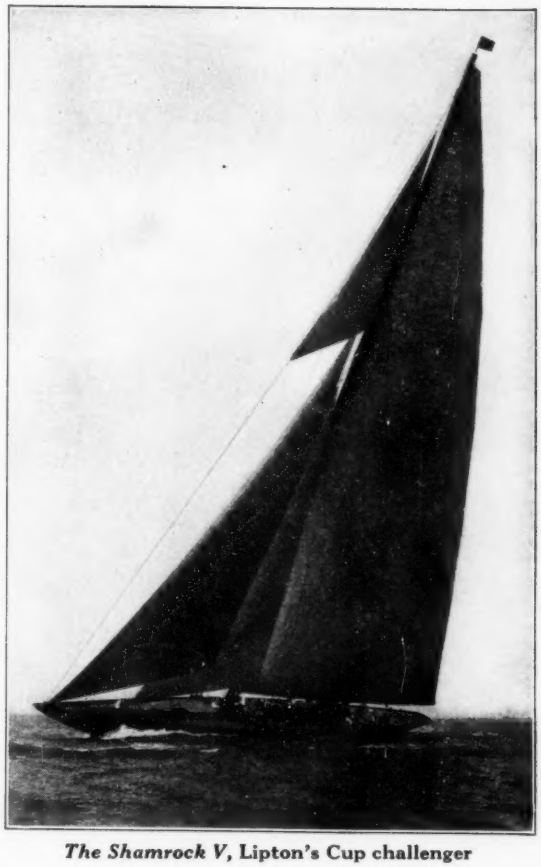
latter being the big three-masted schooner *Brilliant*. The race was sailed in a variety of light, fluky winds, and with strong tides to contend with, but the *America* won rather handsomely. The original records of that race are not clear as to the time by which *America* finished ahead of the second boat, but the New York Yacht Club records give it as 18 minutes.

The Cup thus represented almost the sole proceeds of that summer adventure, and some six years later, or in 1857, it was turned over to the New York Yacht Club by the syndicate which built the *America*, to be put up for international competition, and has been held by that organization ever since. The race this year marks the 14th attempt to capture it, all the challenges coming from Great Britain, with the exception of two from Canada. Also, this last challenge by Sir Thomas Lipton makes the fifth attempt the Irish baronet has made to "lift the mug," as he expresses it, the first having been in 1899, just 31 years ago. All of his yachts have borne the name of the four-leafed clover so dear to Irish hearts.

OF late years the cost of building and campaigning a yacht for Cup defence has become so great that it has become a matter for syndicates to handle, rather than individuals, as was the case with most of the Cup yachts up to the time of the *Vigilant*, in 1893. So when this last challenge was received, those interested in seeing a proper defence assured started to form syndicates for the building of candidates to meet the *Shamrock V*. In a short space of time no less than four such syndicates were formed, and work on the design and construction of the four yachts went merrily forward. It is estimated that to build and race a Cup yacht of this size costs between 700,000 and 800,000 dollars.

In the matter of design we found ourselves confronted with a situation which was somewhat unique, inasmuch as none of our active naval architects had ever designed an America's Cup yacht, and few of them had turned out a racing cutter of the size called for. "Nat" Herreshoff, of Bristol, and William Gardner, who created the two candidates for the race of 1920, had both retired and were out of the picture. So the four syndicates turned to three of our younger designers, and to Clinton H. Crane, who is no longer pursuing naval architecture as a profession, but who recently turned out several smaller successful yachts as an avocation.

Towards the race this year the New York Yacht Club displayed a very liberal attitude and suggested to Sir Thomas that instead of his building to a specified water-line length, as in the past, and their meeting him with a boat of the same water-line length, that he build to one of the regular classes of the New York Yacht Club, in which event we would build to the same class and race him boat for boat, without time allowance. Heretofore the yachts have raced with time allowance, so that sometimes the first boat to finish did not turn out to be the winner, which was often unsatisfactory and confusing to the general public.

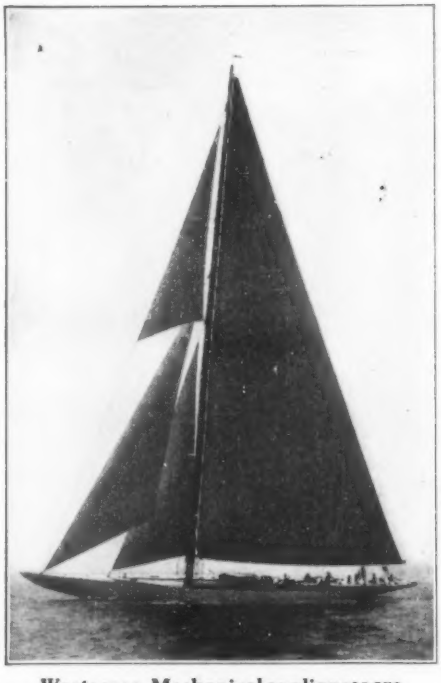


***The Shamrock V*, Lipton's Cup challenger**

SIR THOMAS accepted and elected to build to Class J, or 76-feet rating. Therefore, all of our boats were built to this rating also. This 76-feet rating does not mean that the boats are of this length, but that the resulting measurement derived from a formula taking into consideration length, displacement, and sail area will be 76 feet. As a matter of fact, the various yachts built for this year's race vary in water-line length from about 80 to 86 feet, and in tonnage (displacement) from 128 to 158 tons, all with approximately the same sail area. This allows plenty of scope in design to assure that the boats would not be of exactly the same form and dimensions. The over-all length varies from 120 to 130 feet in our four candidates. With the modern Marconi, or jib-headed rigs that modern yachts carry, all of the boats have extremely long, hollow masts, varying in height from 162 feet to 168 feet. As these are made in one piece, with no fidded topmasts, as in the case of the older yachts, it means that particular attention must be given to proper staying of the masts in order to keep these long slender spars in the boat, and many fears are being expressed as to the possibility of the masts giving way in a hard breeze and jump of sea, such as are likely to be met off Newport in September.

Another forward step this year in these defenders is that the hulls are all built to Lloyd's scantling requirements, which means very substantial construction as compared to the defenders of recent years, in which every sacrifice

Deck view of the *Whirlwind*. She is a double ender with canoe stern. This is the first time this form of stern has been used in an America's Cup yacht



***Weetamoe*. Mechanical appliances are used for handling halliards and sheets**

was made to lightness. This practice went so far that it was considered unsafe to race in a wind which to the early Cup boats would have been only a whole-sail breeze, and resulted in one of the races of 1920 being called off in a wind of only some 25 miles-an-hour strength. Also, it means less of a handicap to the challenger, for as our boats are built to the same scantling (or frame) dimensions, they have to be as substantial as the *Shamrock V*, which, to race, must sail across the Atlantic on her own bottom.

ANOTHER feature of modern yachts built for the defence of the Cup that marks a great departure from previous practice is in the mechanical contrivances for handling gear. Below decks, on all the boats built for this race, no accommodations of any kind for the crew are to be found. The entire personnel of each yacht, from 22 to 24 men, is berthed and boarded on a large tender, which follows the yacht to which she is attached to the various ports where she may base. This leaves room below for the stowage of various light sails or "kites" which these boats must carry to make the most out of every vagary of the wind, and for the many winches and drum hoists for handling halliards and sheets. The halliards for all except the lightest sails lead to mechanical hoists below, while the main sheets and some of the headsail sheets also are led to winches below, where a gang of men takes in on them or slacks them off on signal from deck. This is a far cry from the traditional method of all-hands tailing on to sheet and halliard to hoist or trim sail, as in the days of the *America*, and all of those yachts which followed her in the quest for the Cup up to quite recent times

The four yachts built for this year's defence are the *Weetamoe*, *Enterprise*, *Yankee*, and *Whirlwind*. A comparative table showing the principal dimensions of these boats, and of the challenger, *Shamrock V*, is given, and the details of ownership and design follow.

Weetamoe, Racing Number 1. Designed by Clinton H. Crane. Built by the Herreshoff Mfg. Co., Bristol, R. I. She is for a syndicate organized by J. P. Morgan and Junius S. Morgan, Jr., the other members being Henry Walters, Cornelius Vanderbilt, Arthur Curtiss James, Gerard B. Lambert, and George T. Bowdoin. Former Commodore George Nichols is managing owner and skipper and will sail the yacht throughout the season. With him on the quarter deck are John Parkinson, Robert N. Bavier, A. H. Eustis, and Junius S. Morgan

Yankee, Number 2. Designed by Frank C. Paine, a son of General Charles J. Paine, who owned or managed the Cup defenders *Puritan*, *Mayflower* and *Volunteer* in 1885-6-7. Built by George Lawley & Son, Boston, for a Boston syndicate composed of John T. Lawrence, Chandler Hovey, and Frank C. Paine. The first named is syndicate manager, and in the afterguard with him are Raymond Hunt, Frank Paine, Chandler Hovey, and, on occasion, Charles Francis Adams, Secretary of the Navy.

Whirlwind, Number 3. Designed by by L. Francis Herreshoff, son of the famous Nathaniel Herreshoff, the "Wizard of Bristol," who designed all our previous Cup defenders since 1893. Built by George Lawley & Son, Boston, for a syndicate organized by Paul Hammond and Landon K. Thorne, of New York, who will sail her in her races, with Adrian Iselin, II, assisting.

Enterprise, Number 4. Designed by W. Starling Burgess, son of Edward Burgess who turned out the successful defenders *Puritan*, *Mayflower*, and *Volunteer* mentioned above. Built by Herreshoff Mfg. Co., Bristol, R. I. She is owned by a syndicate headed by Harold S. Vanderbilt, and consisting, beside himself, of W. W. Aldrich, Commodore Vincent Astor, George F. Baker, Floyd L. Carlisle, Ogden L. Mills, E. Walter Clark, and George Whitney. Harold Vanderbilt is her skipper, and sailing with him are C. Sherman Hoyt, C. F. Havemeyer, W. W. Aldrich, and the designer, Starling Burgess.

All of these four yachts, excepting the *Whirlwind*, are built with bronze plating over steel frames. The decks

Sail plan of a modern Cup defender

are of wood. The *Whirlwind* is of composite construction, with a double planking of wood over steel frames. This latter boat is a double-ender, the ends of the others being of moderate length for a modern yacht and of conventional form. Each of the defenders is fitted with a small centerboard, excepting the *Whirlwind*.

WHILE the four American Cup candidates have been racing since June, the actual defender will not be named until after a series of official trial races to be sailed off Newport, over the Cup course, between August 20th and 30th. After this selection is made, the following two weeks will be spent polishing up the successful candidate to get her in the pink of condition to meet *Shamrock V* in a series consisting of the best four races out of seven, starting September 13th, nine miles southeast of Brenton Reef Lightvessel. And, then, may the best boat win!

	Weetamoe	*Yankee*	*Whirlwind*	*Enterprise*	Challenger *Shamrock V*
Length water line	83–0	84–0	86–0	80–0	81–0
Length over-all	125–11	126–0	130–0	120–9	119–10
Extreme breadth	20–3	22–6	21–7	21–8	19–8
Draft	15–0	14–9	15–6	14–5	14–8
Displacement (tons)	143	145	158	128½	134
Sail Area (sq. ft.)	7568	7550	7550	7583	7540
Height of mast	164	162	166	168	163

Principal dimensions of the Cup yachts

Crash-Testing Tires at High Speed

WHICH of these will best stand the force of tremendous impact: A 10-ton brick and concrete wall, reinforced with steel, and sunk deep in earth, a 3000-pound eight-cylinder automobile, or a few pounds of rubber and compressed air?

The answer to this question was given when Captain Dick Grace drove an eight-cylinder touring car under full power at 37 miles an hour into a solid wall over three feet thick. When the car crashed, the entire wall, 15 feet wide, was moved several inches from its base, the powerful car was wrecked and the front end was demolished, Captain Grace was hurled high in the air by the impact, falling beside the car, but the tires on the car were not damaged in any way despite the fact that they had received the full force of the impact.

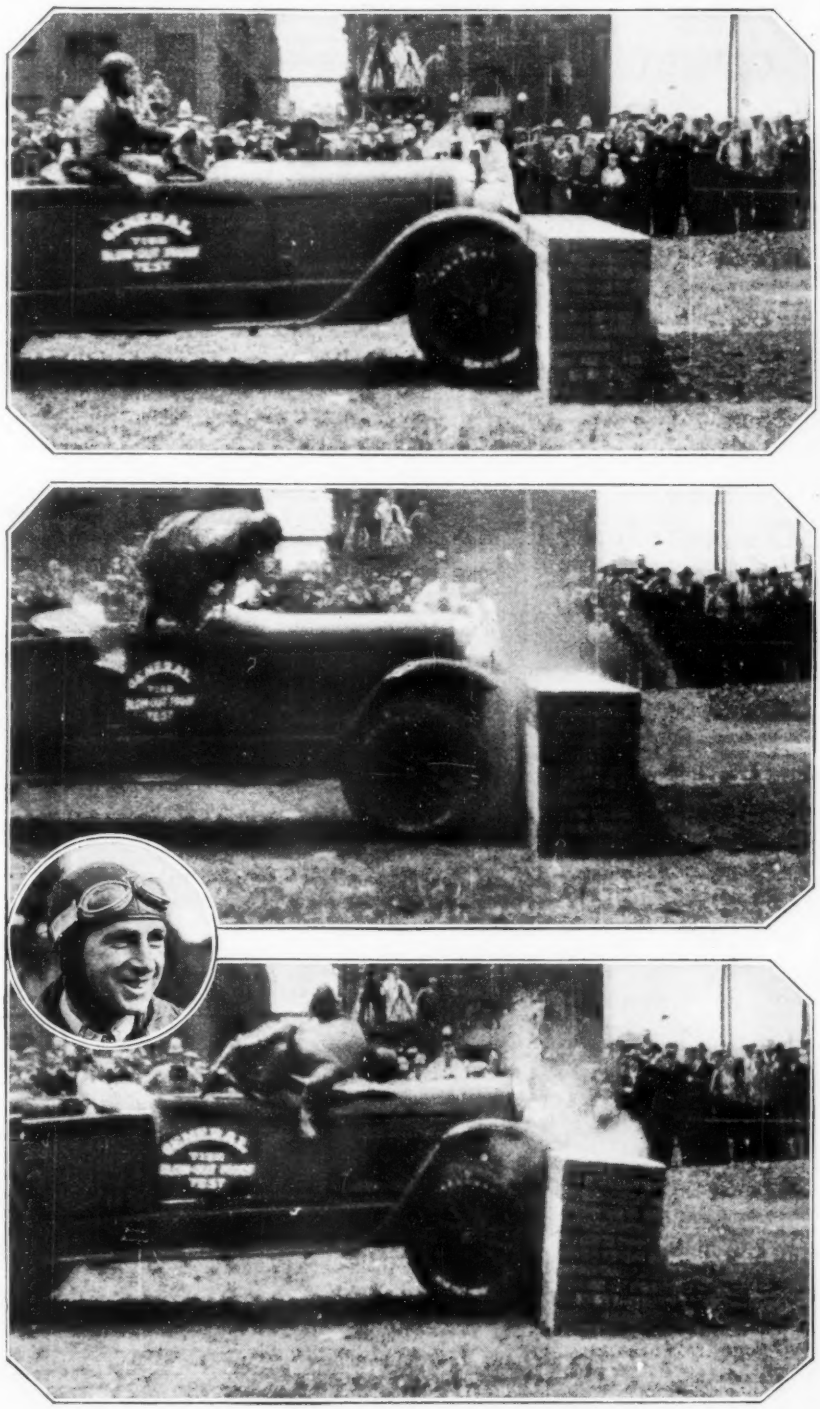
Because of the daring exploits of Captain Grace who intentionally cracked up airplane after airplane to furnish thrills in "Wings," "Lilac Time," and other spectacular air movies, the General Tire and Rubber Company asked him to give its new blow-out proof tires the most severe test he could devise. On the company athletic field, engineers built a brick and concrete wall, 15 feet wide, over three feet thick, and six feet in height, half of it buried underground. A heavy steel I-beam was built into it to reinforce it.

Captain Grace selected a powerful, eight-cylinder touring car with which to make the test. Before it was equipped with the new tires, the front wheels were moved forward so that they cleared the front springs and frame by six inches, making it certain that the tires would get the full impact of the crash. Then Captain Grace circled the field several times, gaining momentum for the final run.

The tires uninjured after the crash although the rim was badly bent

Just before the crash, he raised himself in his seat in a crouching position. With the throttle wide open, the car crashed into the wall, head-on. Slow-motion cameras revealed that the impact flattened the tires back against the rims, which were bent out of shape but the tires were uninjured.

"Such a test shows," said Captain Grace, "that tires will withstand the shock of driving over all kinds of roads at high speeds, even though they are driven unexpectedly into deep holes in the road."



Oomph! The car strikes the wall at 37 miles an hour. The upper left picture shows the flattened tires at the moment of impact; the center picture, the rebound; at bottom, the moved wall and the catapulting driver. In the inset, Captain Dick Grace

Our Patent System

By ORSON D. MUNN

Member New York Bar

THE Use and Abuse of Patent Rights: Just What Rights Our Patent Laws Grant to Patentees: The Government Cannot Give a Patentee the Right to Use the Invention of Any Prior, Existing Patent: Patents for Improvements Are Frequently More Valuable Than Pioneer Patents: Today, as Always, a Patentee Receives the Protection of the Government, in so Far as His Patent Rights Are Concerned, as Well as His Just Reward

THERE has been much unfavorable comment recently concerning our patent system. A western Senator has introduced a bill designed to prevent what is alleged to be the abuse of the rights secured by patents. The Government has instituted a suit against the so-called "Radio Trust," in which it charges that large and powerful corporations, holders of alleged "all-covering" patents, have by means of cross-licenses and agreements practically made it impossible for the independent manufacturer in the radio field to exist. We find others criticising our patent system because of the ineffectiveness of patents and the alleged lack of protection extended by the Government to inventors and patentees in general.

To determine whether or not the proposed legislation and the Government's action on the one hand, and the criticisms of the futility of patent protection on the other hand, are justified, we should first consider just what a patent is. It has been defined as a limited monopoly based on a contract between the patentee and the Government, wherein the Government, as an inducement to the patentee to make his invention known and useful to the people of the United States, promises to the patentee that for a limited period no one shall have the right to make, use, and sell his invention, without his consent. At the end of that period of time the patented invention becomes public property and may be employed by anyone. The rights secured by a patent are exclusive and the Constitutional provision under which inventions are protected provides only for the making of laws to secure "exclusive" rights to inventors. It is extremely doubtful whether Congress could pass any law, under this Constitutional provision, providing for the grant of anything less than an exclusive patent.

THERE are many who do not comprehend just what rights are given to a patentee by his patent. Many believe that a patent from the Government confers upon the patentee the absolute right to make, use, and sell his invention throughout the United States; but this is not the case. What he really gets is the right to exclude all others from making, using, and selling his invention. Obviously, this must be so, because many patents are granted for inventions which infringe prior patents; in other words, for improvements on the inventions of prior patents. Such improvements, everyone will agree, are patentable; but because they are patentable, the patentees get no right to use them if they embody the invention of a prior, existing patent. Our Government cannot take away from one citizen his property and permit its use by another—such monopolies were never granted by our Government—so that when the patentee of an improvement gets a patent from the Government which, in terms, gives him the exclusive right to make, use, and sell his invention, he must remember that he does not get the right, and the Government cannot give him the right, to use the invention of any prior, existing patent.

Patents for so-called improvements are in many instances more valuable than a so-called "pioneer" patent. A case in point is the Bell telephone patent of 1877, which may rightly be designated as a "pioneer" patent. During its life many valuable patents were granted for improvement in the telephone art, and it may be conceded, without detracting from Bell's great achievement, that the practical

commercial telephone was developed by these subsequent inventors; but not one of those patented devices could have been used by the owners without the consent of the owners of the Bell patent. Each of them secured to the patentee exactly the same rights that were given to Bell; that is, the right to exclude everyone from using the patented invention without the consent of the owner of the patent.

A patentee having this right of exclusion may do with his patent what he pleases, within the law. He may never put the invention in use during the term of the patent, and yet, he does not lose the right to exclude all others from using it. Having this exclusive right he may sell his patent to whom he chooses, or he may refuse to sell it. He may grant a license to anyone whom he chooses to license or he may refuse to license anyone; also, it follows that he may license those whom he feels like licensing and refuse licenses to others. In all of this no one has the right to complain; not even the Government which granted the patent.

BUT the Government charges that in some instances, as in the so-called "Radio Trust," these patent rights are used in such a way as practically to control the particular art and to eliminate competition, thus monopolizing the business of a particular industry. That this can be done is true, and no doubt patents can be and are used unjustly to intimidate competitors and to drive them out of business. Naturally, the Government cannot and does not complain that the owners of patents have granted licenses and cross-licenses to each other, because that is within their right.

Whether a corporation owns one patent or a hundred, or whether it be licensed under one patent or a hundred is immaterial, because each patent must stand or fall absolutely independently of all other patents, and the monopoly created by a patent is not expanded in the slightest degree by the fact that numerous patents are combined. It is true that a number of patents may afford a more extended protection to a given manufacture than would a single patent; but no one can complain of that. It is another thing, however, to say that an agreement between licensees and owners of patents that they will never license any others than themselves, is within their patent rights. That is the thing to which the Government objects; such agreements are not justified by the patent grant and are clearly in violation of our laws aimed to prevent monopolies and restraints of trade.

Again, patents may be and are used to intimidate independent manufacturers by unjustified charges of infringement and threats of litigation made not only to the manufacturer of the device alleged to infringe, but to the trade, and as the user or retailer is liable for infringement as well as the manufacturer, it follows in many cases that as an alternative to expensive litigation the manufacturer ceases the manufacture of the device alleged to infringe and the retailer not only refuses to buy them for resale, but oftentimes returns to the manufacturer those which he has already bought.

It would be entirely proper for Congress by some appropriate legislation to penalize those who make an improper use of patents in this manner, even to the extent of providing that they shall be deprived of all relief in a suit instituted by them charging infringement, should such a misuse of their patents be pleaded and proved against them. Indeed, without the proposed legislation, courts of equity have frequently denied all relief to the owner of a patent who has maliciously sought to destroy the business of his competitor, by circulating among the trade warning notices of infringement prior to an adjudication of the question of the suit. This, on the ground that the owner of such a patent comes into court with unclean hands and is not entitled to ask a court of equity for any relief.

The criticism, however, that patents do not protect inventors and patentees, and the suggestion that the Government should in some manner enforce the patents which it issues, is without any foundation whatsoever. It has been stated that no patent is of any validity until it has been through the courts, and that when one gets a patent all he gets is the right to a law suit. In just what manner the critics would have the Government proceed is not suggested.

IT is clear to anyone, however, that a valid patent is a protection to the patentee or owner of a patent, and that the Government does in fact protect him in his rights secured by a patent. The courts are always open to him, and it must be known to everyone that the courts constitute a branch of our Government.

The courts, it is true, will only extend their protecting arm to those patents which they find to be good and valid; but this is true of all contracts. No contract is self-executing. When you enter into a contract all you have is a promise in writing, which, if evaded and avoided and disregarded you must go to the courts for enforcement; and like a patent, such contract will only be enforced if the terms thereof are clearly stated and it is not invalid. A patent is no different in this respect from a deed for a piece of real estate; in fact much land in the west is held under patents issued by the Government. You cannot eject a trespasser from your property by simply waving before his eyes your deed and you cannot complain to a policeman to put him off of what you say is your property, because the policeman does not know whether it is your property or not. He may rightly differ with you as to whether or not he is a trespasser, or whether or not your patent is a valid patent. So that in all cases of contracts, patents, deeds, and agreements of any nature, you must seek the assistance of the courts to enforce them.

On the other hand, unadjudicated patents in many cases have proved of great value and been the source of much profit to the owners. In fact, there are instances where an inventor has sold his invention and the right to a patent even before the patent has been applied for or issued, and there are also many instances where an alleged infringer has recognized not only the validity of the patent but the fact that he has actually infringed the patent, and has ceased his infringing acts, or, by treaty with the owner of the patent, secured the right to continue the use of the patented invention. The owners of patents do not always have to go into court to obtain recognition of their patent rights and to receive the benefits to which they may be entitled.

NO inventor, and no patent owner, should permit the present agitation, and the unjust criticisms of our patent system to deter them from creating new inventions and seeking patents therefor, nor should they be disappointed if the thing for which they have obtained a patent should not prove as valuable and useful as they anticipated. The Government is obliged to grant patents for new and useful inventions, but, obviously, there is no place in the arts for many of these patented inventions, either because they are impractical, or because there are things in existence for doing the same work, equally as efficient and economical, or because there is not sufficient capital available for commercial exploitation; under such circumstances no patentee should expect to profit by his invention. On the other hand, many cases can be cited where the inventors of simple things for which they have sought and procured patent protection have been amply rewarded and to an extent they never anticipated. It is true today, as it has been in the past, that the inventor or patentee of anything which materially benefits a given art or industry will not only receive the protection of the Government in so far as his patent rights are concerned, but also that reward, financial and otherwise, which the scope and value of his invention justifies.

More About the Peking Man*

By PROFESSOR G. ELLIOT SMITH, F.R.S.

Professor of Anatomy in the University of London
Author of "The Evolution of Man," and "Human History"

THE revelation of the nature of the brain-case in Early Pleistocene man displayed in the wonderful photographs reproduced in these pages affords ample corroboration of the claim made in *The Illustrated London News*† that the discoveries in China provide "a new basis for the study of human evolution." These photographs were made in Peking immediately after Professor Davidson Black had successfully accomplished his long and exacting task of clearing away the hard matrix of travertine in which the base and left side of the skull were embedded when it was found on December 2, 1929, by Mr. W. C. Pei.

The top of the skull of Peking Man, or *Sinanthropus pekinensis*

Now that the stony matrix has been removed from the surface—the cranial cavity is still occupied by a solid mass of travertine—there is revealed the most complete example of an Early Pleistocene skull so far discovered. It is a very impressive and illuminating specimen, not merely for the intrinsic evidence it provides, but also for the light the new data shed upon the other remains of early man. It is the skull of a young adult or adolescent. Mr. Davidson Black suggests the possibility that it is female.

For the elucidation of its distinctive characters I have made two series of drawings in which the left profiles and the views from behind of the only three Early Pleistocene skulls so far known are shown superimposed upon one another. These drawings reveal the individuality of the new genus from China. While it has the prominent eyebrow-ridges of *Pithecanthropus* (which are lacking in the Piltdown skull), the brain-case is much fuller than the Java skull, especially in the frontal region, which approximates to the condition found in Piltdown man. But the latter is much better developed in the parietal and occipital regions than either of the Far Eastern skulls. The most striking contrast between the cranial forms of *Pithecanthropus* and *Sinanthropus* is revealed in the view from behind, in which the greater height and development of parietal eminences in the Chinese skull definitely differentiates it and justifies its generic distinction.

Sinanthropus Turns Out to be the Most Impressive and Significant Discovery in the Whole History of Human Paleontology

When Sir Arthur Smith-Woodward made his reconstruction of the Piltdown skull from the broken fragments found in 1912, he was vigorously criticised for making a model wider at the base (see the temporal bosses) than in the parietal region. The Peking skull reveals these peculiarities in a more extreme form. As it is an actual skull, and not a reconstruction, it provides welcome corroboration of the reliability of the reconstructed Piltdown skull. The outlines of the profile and posterior aspects of the Piltdown skull in the diagrams are taken from Figures 17 and 19 of my "Evolution of Man" (1927).

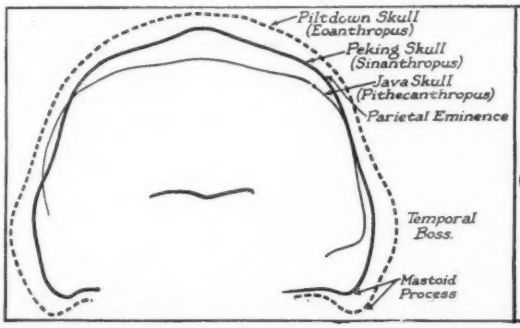
In his manuscript notes accompanying the photographs Professor Davidson Black claims that such a form (as is revealed in the posterior view of the Peking skull) is unknown in any other human skull. My drawings demonstrate the same peculiarity in the Piltdown skull. The collective testimony of these three fossils provides an impressive idea of the likenesses (as well as the generic differences) of these Lower Pleistocene men, and suggests the common denominator of the earliest man. The peculiarities already mentioned in the temporal part of the skulls (note, in particular, the temporal bosses in all three) do not exhaust its interest. The form of the mastoid processes (which seem not to have been fully extruded—as they are in other men—from the cranial wall) and the massive ring of rough bone (tympanic) surrounding the ear-hole, differ profoundly from the corresponding parts of all other human skulls. The peculiar modeling of the tympanic bone displays a startling resemblance to the condition found in the gorilla and chimpanzee. The mastoid and tympanic structures have distinctive characters in Piltdown Man, Rhodesian Man, and Neandertal Man, but none of these is so emphatically simian in type as the Peking skull.

WITH the photographs of the skull there has also come Volume VIII of the "Bulletin of the Geological Society of China," containing three important memoirs which throw a clearer light upon the history of the discovery of *Sinanthropus* and the geological and paleontological evidence for the antiquity of the human fossils and the animals associated with them. The Chinese geologist, Mr. W. C. Pei, gives an account of his discovery of what is probably the most important, and certainly the most illuminating, fragment of early man ever found. Father Teilhard de Chardin and Dr. C. C. Young have provided a preliminary report on the fossiliferous deposits at Chou Kou Tien, which not only establishes the fact that all the

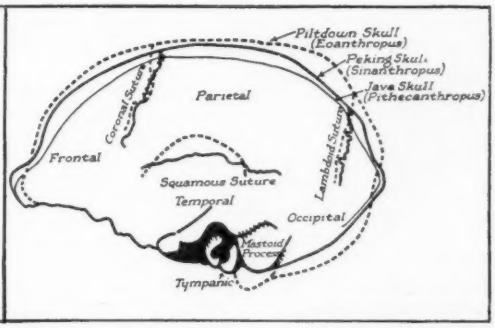
The skull of *Pithecanthropus*, for comparison with that of *Sinanthropus*. **(See also opposite page)**

*Reproduced by permission of *The Illustrated London News*.

†The article in question, written by Professor Smith, was reprinted in SCIENTIFIC AMERICAN, June 1930, page 440.



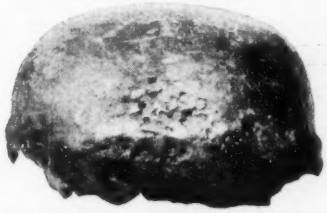
With posterior aspects superimposed, three famous skulls—Piltdown (*Eoanthropus*), Peking (*Sinanthropus*), Java (*Pithecanthropus*)



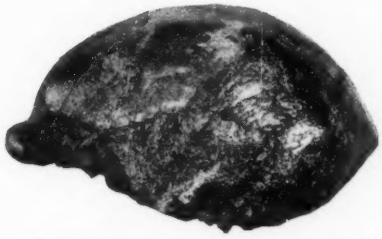
Left profiles superimposed. The same three skulls whose posterior profiles are superimposed at the left. Drawings by the author

Base of the skull of *Sinanthropus* (the round central object is recent)

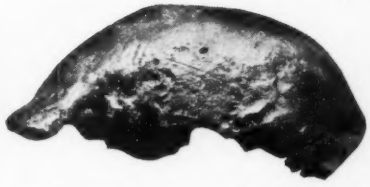
Sinanthropus, rear. The parietal eminences mentioned in the text are indicated in the drawing above



Pithecanthropus, rear. For position of "temporal boss" see the drawing



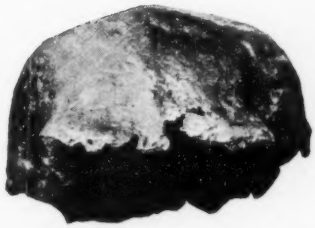
Sinanthropus, profile. It has a fuller brain case than *Pithecanthropus* (which is shown at right)



Pithecanthropus, profile. *Sinanthropus* (at left) has the same or more prominent eyebrow ridges

Base of the skull of *Pithecanthropus*—smaller than *Sinanthropus*

Sinanthropus, front. Happily the eyebrow ridges are not even partially lost, as in *Pithecanthropus*



Pithecanthropus, front. *Sinanthropus* has the same frontal expansion as has *Pithecanthropus*

remains are later than the Pliocene and earlier than the Loess—in other words, they are Lower Pleistocene—but also hints at the possibility that in the lower layers of the formation (the highly fossiliferous beds of Nihowon) they may find "some immediate ancestor of *Sinanthropus.*" Professor Davidson Black has described (with many excellent photographs) the process of liberating the skull from its matrix.

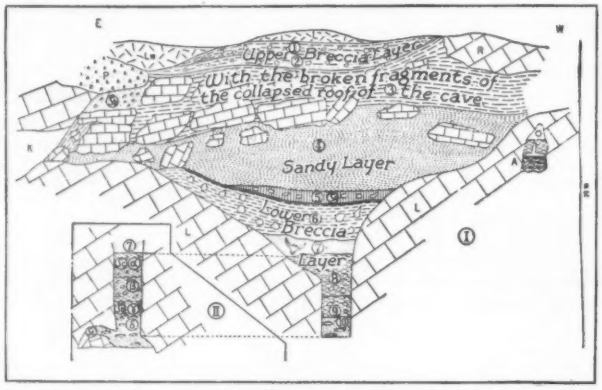
The evidence provided in these three memoirs makes it possible for us in Europe for the first time to visualise the circumstances of this epoch-making discovery. These facts are essential for the understanding of the significance of the new light on our remote ancestry. For several decades European paleontologists have been exploiting the druggists' shops of China for fossils — "dragon's bones" being an important item in the pharmacopœia of the Far East. But it was not until 1919 that a subsidiary bone deposit near Chou Kou Tien was visited by Dr. J. G. Anderson on behalf of the Geological Survey of China. Two years later (1921) he discovered the important main deposit and began excavating it. But its exceptional scientific importance was not realised, even when in 1926, Dr. O. Zdansky found two human teeth among the fossils that had been collected. The Rockefeller Foundation then gave a grant of money to help the Geological Survey of China and the Department of Anatomy of the Peking Union Medical College conjointly to carry on excavation for two years.

IN October 1927, Dr. Birger Bohlin found *in situ* in the Early Pleistocene beds a human tooth, on the evidence of which Professor Davidson Black and Dr. O. Zdansky created the new genus and species *Sinanthropus pekinensis.*

Dr. Zdansky was still sceptical of the justification for the creation of a new genus and species, and the credit of insisting upon the necessity for such action must be attributed to the insight and courage of Dr. Davidson Black, who naturally associated Dr. Zdansky's name with the discovery in view of the circumstances under which the two teeth were rescued in 1922 and described by him in 1926.

A year later (November 1928), Mr. W. C. Pei, working with Drs. Birger Bohlin and C. C. Young, found much additional material, including parts of two lower jaws and numerous skull-fragments of *Sinanthropus.* This induced the Rockefeller Foundation to make an additional grant for the work, and a special department (Cenozoic Research Laboratory) was set up by the Geological Survey of China and put under the honorary directorship of Professor Davidson Black.

The hope implied in the granting of this new appropriation was immediately realised by the most impressive and significant discovery in the whole history of human paleontology. Mr. Pei resumed work in May 1929, and in June and July found a number of human teeth. The summer rains then stopped work for seven weeks, so that it was not until September 26 that excavation could be resumed. Another collection of *Sinanthropus* teeth was then found.



Where "the most illuminating fragment of early man ever found" was discovered—at point marked "SE" (extreme lower left-hand corner). The jaw and skull fragments found a year earlier were at "SB," (top, left)

At the end of November, when the weather was becoming bitterly cold, Mr. Pei was so "curious to know what were the lower layers of the deposit" that he prolonged the work for two more days. He found two caves, in one of which, at 4 o'clock on December 2, he found, "partly embedded in loose sand and partly in a hard matrix," the almost complete skull of *Sinanthropus.* He sent special messengers to inform Drs. W. H. Wong and C. C. Young, and telegraphed to Dr. Davidson Black.

THE circumstances under which the remains of *Sinanthropus* were found are totally different from those of *Pithecanthropus* and *Eoanthropus.* The latter were both scattered and deposited in gravels by running water. The Peking Man lived in caves, and left his remains there. According to Father Teilhard de Chardin and Dr. Young, it is probable that not only the rodents, hyenas, bears, and other carnivora roamed the site, but also *Sinanthropus* himself may once have sheltered within the Chou Kou Tien cave. Vast quantities of fossil bones have been found. The most interesting types, apart from *Sinanthropus,* are the big beaver (*Trogontherium*), the primitive water-buffalo (*Bubalus*), and the strange deer (*Euryceros*), whose extremely thickened jaws and facial bones and short, flattened antlers are perhaps the most characteristic of the fossils found at Chou Kou Tien. *Machairodus* is exceedingly rare.

The fossils are scattered in the layers filling the cave from top to bottom, and all belong to the same geological age. While a few of the bones may have been introduced into the deposit by a brief flood action (*Bubalus,* for example), most of the material was clearly left (or brought in) by animals living in the cave. The fossiliferous material was set by a slow process of weathering under humid conditions (water infiltrations and occasional brief flooding), but without any torrential action. Although a stream flowed near the cave, there are no true river-deposits. The characters of the breccia and of the fossilised bones indicate that the site was not an underground, water-drained fissure, but an ancient, gradually filled, open-air cave.

SUCH was the home of *Sinanthropus.* The conditions arouse more reasonable hopes than can be entertained in the cases of *Eoanthropus* and *Pithecanthropus,* not only of finding other parts of the skeleton, but also the objects used by Peking Man. It is surprising that no implements have yet been found in the cave. Mr. Pei recovered an angular piece of quartz—a type of stone not found naturally—within a mile of the cave. Similar quartz-fragments have been found from time to time during the course of the excavations, but in none of them has any recognizable trace of artificial breaking been found. It is inconceivable that any creature which had attained human rank could have failed to make some sort of tools of stone. Yet Peking Man occupied this cave for a long time, and does not seem to have left with his bones anything beyond some unworked quartz!

Alongside the skull of *Sinanthropus* was found the complete skull of a rhinoceros, with its lower jaw in position. Mr. Pei ends his reports with this passage, which excites the liveliest anticipations of what next summer may bring forth: "The layer below the one just described is exceedingly rich in fossils, which are so crowded together that but little matrix separates individual bones. Not only are the fossils rich in quantity, but their quality is extraordinarily good."

Arcs of Art

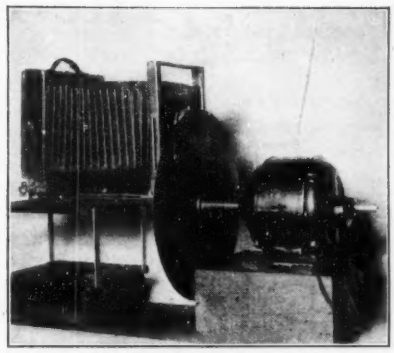
The Camera Analyzes the Electric Arc

By HENDLEY N. BLACKMON

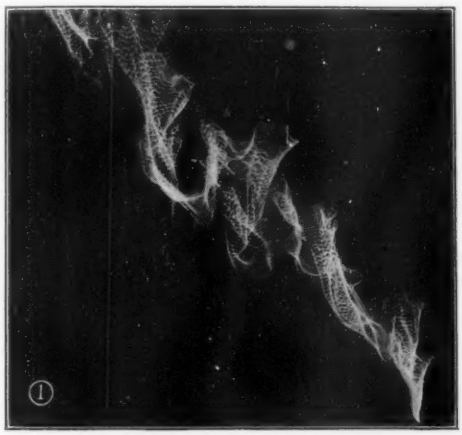
General Engineer, Westinghouse Electric and Manufacturing Company

SOME electric arcs form a most exquisite tracery—a weird gossamer picture of bright and dark bands of light emerging from a misty halo. These striated arcs are made by bringing one end of a 150,000-volt wire close enough to the other terminal for an arc to jump across. Once started, the arc hangs on until it is "stretched to death" when the terminals are pulled far apart.

In order to find out what happens at various points on the changing voltage wave, an electrically timed camera was used. This camera has a synchronous shutter consisting of a motor-driven disk with four radial slots, rotation of which times the camera to take pictures of the arc at any desired portion of the voltage wave. The pictures it makes show the physical characteristics of unleashed electricity and have helped scientists in solving the problem of the behavior of electric arcs.

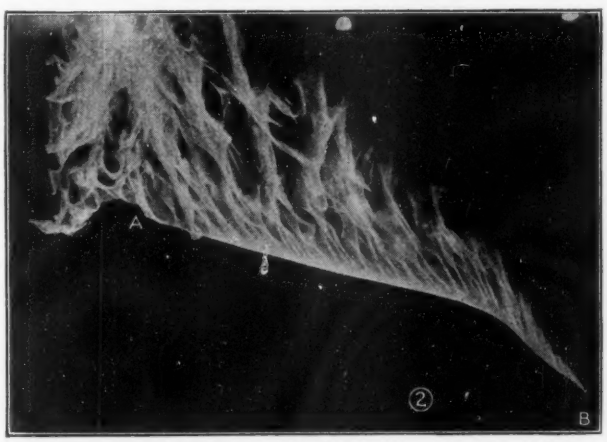


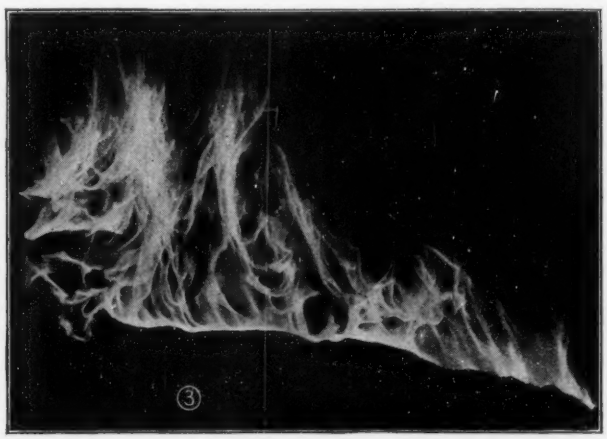
The arc-photographing camera with its motor-driven disk shutter

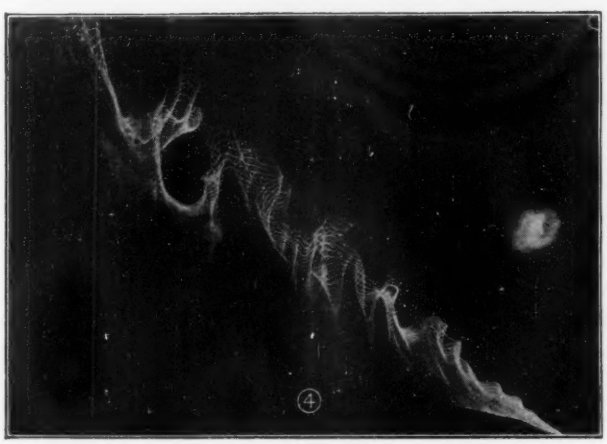


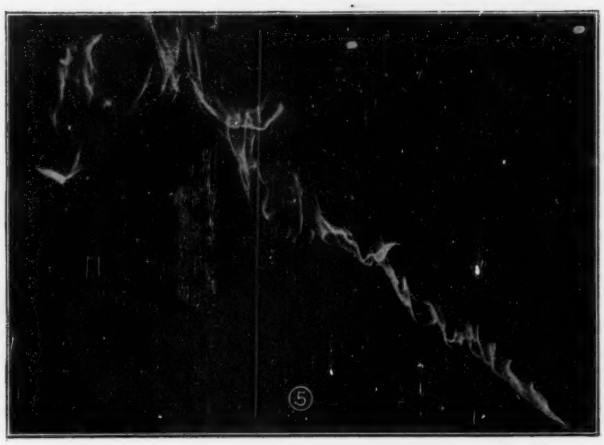
In the accompanying illustrations, Figure 1 shows how the halos are masked out by the synchronous shutter. Figure 2 shows what happens in the life of the arc: the arc began at "A" when the electrodes were 1½ feet apart, and was stretched 8 feet so that it finally went out at "B." The arc trailed off like a comet because at the left the electrodes were close together and more power was produced. As the arc was drawn out, the heated air carried the flame upward, the flame decreasing as the air gap was widened.

Figure 3 shows the sort of picture obtained by not opening the camera shutter until the arc has been drawn out quite a distance. Figure 4 was taken under the same physical conditions as Figure 1, but the halo is not masked out entirely; note the halo at the bottom and the sharply defined layers at the top of the arc. Figure 5 is a snaky specimen of the striated arc.









The Pattern of Evolution

A Criticism of Doctor Austin Clark's Thesis†

By W. D. MATTHEW, Ph. D.

Professor of Paleontology, Chairman of the Department of Paleontology, and Director of the Museum at the University of California

A GREAT many people are talking about evolution nowadays. Most of them do not know much about it and, generally speaking, the less they know about it the more it horrifies them. The theory of evolution, when you come to know it well, is not only of marvelous and inexhaustible beauty, but is an inspiration to a higher type of idealistic living than any orthodox religion.

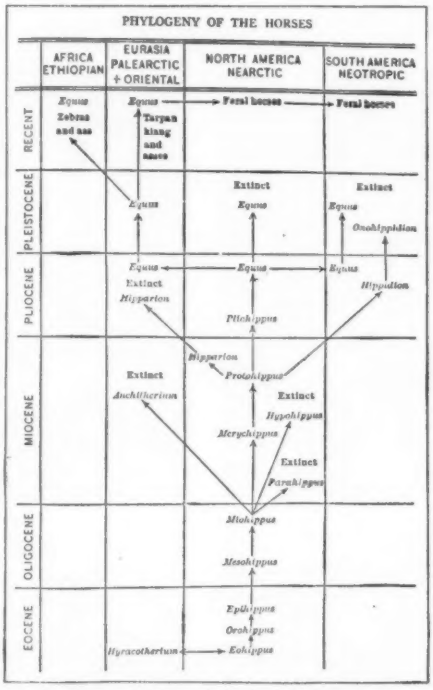
Doctor Clark, as a distinguished biologist and a specialist in certain groups of modern invertebrate animals, is very distinctly one who does know what he is talking about, and his views and conclusions about evolution are entitled to very careful and respectful consideration. If in the following pages I find it necessary to criticize and modify his statements of evidential fact, it should be understood that it is because they lie for the most part in a field that is my specialty but not his, the field of paleontology, and especially of vertebrate paleontology. In a scientific discussion the facts and the immediate interpretations that may legitimately be placed upon them are usually matters that must rest largely upon the authority of specialists. The soundness and validity of the conclusions drawn from these facts are matters of logic on which any reasonable man can and should judge for himself.

IN attempting to explain the principle of evolution (for it is a principle, not a theory, to the paleontologist) as it has actually worked out in the past history of life, certain aspects and effective illustrations have necessarily been selected from the record. These have been popularized and stated in some detail, while other parts of the evidence, often equally convincing but less readily explainable or of less general interest, have been omitted or briefly and casually summarized. This other evidence is quite necessary to any complete understanding of the nature of the record, but much of it is very difficult to get at, published only in technical papers scattered through numerous scientific journals. Much of it has never been printed at all; the specimens and records are stored out of view of the public in the research rooms of various museums, their existence known to the merest handful of specialists.

Such evidence, not yet assembled nor made available to the general student, yet serves to color the thought of specialists and control their interpretation of the better known data. Its existence, and, I may add, its controlling importance in the interpretation of our problems, is the reason why, in the free democracy of science, we may grant "authority" to individuals in their special line of research.

I do not agree with Doctor Clark's conclusions in this essay, because I think he has not fully understood the paleontological evidence, nor the geological and geographical background against which it must be viewed for correct interpretation. But he has quite properly pointed out certain neglected aspects of the evidence which make it less convincing as commonly presented than it really is when fully known.

These lie in two fields. First, that of the fossil record of the evolution of the various races of mammals in the Tertiary period—my own particular subject—and of the different orders of reptiles and classes of vertebrates in preceding periods. Second, the broader problem of the relationship and origin of the great phyla or branches of animal life, of which the vertebrates are one.



In the evolution of the horse there were several branch lines, none of which has survived, as shown in the cut

As concerns the first, I am obliged to take exception to his presentation of the evidence, as incomplete and in this connection misleading, and to his interpretation of it as failing to take into account the geologic and geographic background which controls its significance. He gives a brief and fairly correct summary of the record of the evolution of the horse, tracing it from the little four-toed *Eohippus*. But he does not mention that such diverse animals as the rhinoceros and the tapir are likewise traceable to small four-toed ancestors contemporary with the Eocene four-toed horses, and so like them that the most expert specialists have not always been able to distinguish the one group from the others.

Moreover, he speaks of the equid series as though it were a single line, and has elsewhere spoken of it as "an example of linear evolution." But it is not; there were several branch lines more or less clearly defined, running into parallel or partly diverse adaptations, none of which has survived to the present day. And in each stage of the main line of evolution of the modern horses there were several species, some more, some less in the direct line of descent. The record has, in fact, the familiar form of the phylogenetic tree, continually dividing up into branches and twigs of more or less importance, and the series customarily presented is merely the direct line leading up to the modern horse. From the same common ancestral stock are derived other lines of specialization, each one similarly branched, and two of them surviving today in the rhinoceroses and tapirs.

MOREOVER, the actual record of fossil perissodactyls [hoofed animals with odd number of toes. —ED.] as known to us to-day is obviously a very incomplete one if we view it in the light of geology and geography. The living members of the horse family consist of a number of related species—wild horses in Asia, wild asses in Asia and north Africa, zebras in Africa—scattered over considerable parts of the earth's surface, different species in different

†SCIENTIFIC AMERICAN, August, 1930, Page 104

regions. The rhinoceroses are similarly distributed in southern Asia and Africa the tapirs in Malaysia, and Central and South America. Each family had a much wider distribution at the end of the Tertiary period, and during the Tertiary they were widespread, numerous, and varied through all the northern continents, the living members of the group being a few widely scattered, specialized survivors of a disappearing group, all probably on their way to extinction.

At each successive stage in their evolution, at each epoch of the Tertiary, there must have been numerous different species of "horses," as also of rhinoceroses and tapirs, living in various parts of the northern continents (Europe, Asia, and North America), some ranging over considerable parts of the continent, some confined to restricted areas, slowly shifting their range, becoming more abundant and widespread or less so, as similar animals do to-day.

Courtesy American Museum of Natural History

Side and front views of the evolution of hind feet of the horse. The smallest is *Eohippus*, then come *Mesohippus*, *Miohippus*, *Merychippus*, *Hipperion*, and *Equus*, the modern horse

OUR fossil record, though derived from many places, represents only the animals from small localities, scattered here and there over the continental regions, most of it from a few areas in the middle-western United States and certain parts of western Europe. Out of the dozens or hundreds of species of the family that were living in different parts of "Holarctica" (the aforesaid northern continents) at any one epoch or stage in the evolutionary history, we actually know only a few, and of these one appears to be more directly intermediate than others between the earlier and later stages. It is the closest known approximation to the direct line of evolution.

Our record, then, while it gives a correct picture in a broad way of the evolution of the race as a whole, reduces to a series of approximations more or less close to the detailed and exact phylogeny of any one line of descent. This is the explanation of the "gaps" of which Doctor Clark speaks, and which he thinks, as many other biologists have thought, must be due to some sudden great or considerable change in structure of the same nature as the "sports" with which Darwin and all breeders of plant or animal races were familiar in the last century, and which, under the name of mutations, have been so thoroughly and profitably studied by the geneticists of this century.

But it is not probable, in view of the nature of our fossil record, as outlined above, that the gaps in our evolutionary sequences are many, if any, of this nature. For they are very directly proportioned in numbers and in width to the scantiness and inadequacy of our record. Where the records are most abundant, and especially where we have reason on various grounds to believe that they come from points in or near the center of evolution and dispersal of the race, the habitat of the most progressive species, there these gaps almost or entirely disappear. In general it may be said that the more complete our record of any race the nearer it comes to being continuous, or separated by gaps which, although definite, are not beyond the limits of ordinary individual variation in a species.

The nature of these variations is much better understood than it was in Darwin's time, thanks especially to the researches of T. H. Morgan and his school. Some of them are inherited according to certain definite laws. They are "mutations" of the same nature as the larger, more conspicuous and more occasional mutations which the geneticists have studied in detail. Others are the non-heritable differences between individuals, due to slight or considerable differences in their environment and growth history.

Now it is to be observed that almost any major or conspicuous departure from the normal in an individual would have little or no chance of giving rise to a permanent change in the race. In almost all cases it would be immediately fatal or seriously detrimental to its chances for survival. For each animal is closely adjusted in habits and environment to a particular adaptation, a particular mode of life. With any important single change in its structure it would cease to be an efficient working mechanism. With any conspicuous change in appearance it would become a stranger to its fellows and as unpopular with them as strangers usually are. And even if it succeeded in leaving a few descendants, the chances that these would possess any superiority to their numerous normal competitors would be infinitesimal. Practically all cases in all combinations with the normal would result in an inferior mechanism, sooner or later to be eliminated by natural selection.

WITH the minute heritable differences these disadvantages would not exist. We are familiar with them in our own species and with all animal and plant races.[1] And moreover, the various correlated small differences in other parts of the organism necessary to make an efficient working mechanism can be and are adjusted by individual growth. This is a temporary adjustment, repeated generation after generation until it can be replaced by the appearance of the necessary inherited variations, thenceforward a permanent though small step forward in the evolution of the race.

We must think of each species as it is in nature, each race as it always has been in nature, as a complex of interbreeding strains, each having certain slight differences in inherited characters, intercrossing over and over again until some profitable combination of variations occurs, to be preserved, increased, and finally made universal by natural selection, and disadvantageous characters and combinations eliminated in the same manner. It is a process of almost inconceivable slowness. To change one species of horse into another seems to have required something like half a

1. Men slightly taller than the normal are common, and are apt to excel in many lines of athletics. Seven- or eight-foot giants are rare, and are always more or less crippled and handicapped by their abnormal height, its lack of adjustment to other proportions and to the world they live in. They seldom live to old age and find employment difficult except in the circus. So with any wide and conspicuous variation from the normal. It is of relatively rare occurrence, and *it is a handicap, not an aid to survival.*

million or a million years—two or three hundred thousand generations. No appreciable change would occur in a few thousand years; but in the larger view of the geologic time scale it is seen to be cumulative, resulting in a slow progressive change in adaptation to equally slow changes in climate and environment.

Large changes, conspicuous mutations, can play little or no part in this slow process. A three-toed sport from a four-toed horse would be a cripple. He would not have the numerous correlated adaptations necessary to make of him a good working mechanism, all of which are present in the three-toed horses. No sport that I have ever seen or heard of is at all analogous to such a great series of differences as those that separate the four-toed from the three-toed horses. Very few of the sports and conspicuous mutations would have any chance of survival in competition with the normal members of their race. Still fewer would be those that would be at all likely to give rise to new races. Yet there are a few isolated and exceptional instances among modern animals where certain peculiarities can best be explained as due to such heritable variations of considerable amount. It is the rare exception, and there is no reason to suppose that it played any part in the recorded evolution of the horse.

THE entire history of the perissodactyl order resolves itself then into a branching out from a common ancestry very nearly represented by the *Eohippus* into such diverse specialized types as the horse, the tapir, and the rhinoceros, with various other specialized races that have not survived; and each branch in turn has its minor branches and twigs of which in the horse only one has survived and has itself begun to branch out into horses, asses, zebras, and so on. The record is fragmentary, but no other reasonable interpretation can be placed upon it than to see it as a slow, gradual change quite analogous to the growth and branching of a tree, and like it conditioned in direction, amount, and character of growth, by the circumstances and advantages of the environment, and by the continuity of life. And this is the general pattern of evolution, which we see illustrated in every race of animals and plants whenever our record is adequate to show its real character. The more complete the record, the more precisely it conforms to the pattern.

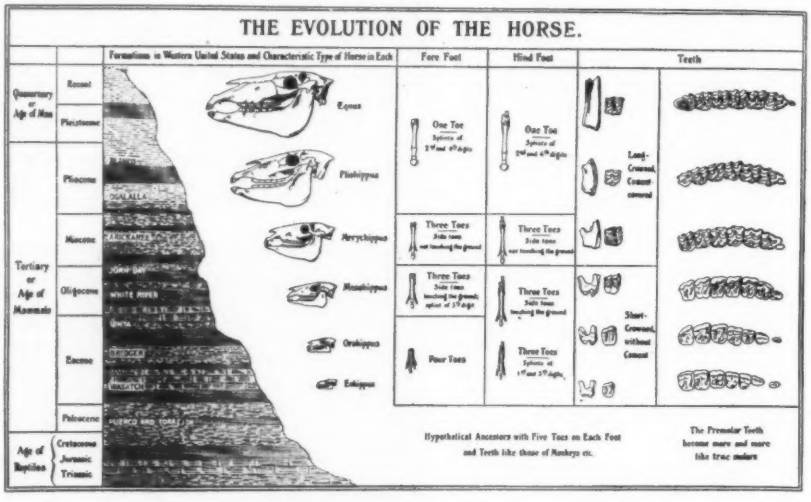
After a "bone-digger" has studied and compared all the known material, fossil and recent, old and new, in a group of animals, and found them all to fit into this pattern; after he has gone into the field and secured new fossils from new formations and previously unknown stages, and found them also fitting into the pattern and filling some of its gaps; when he has repeated the operation on group after group, and learned from reading and conversation that it is identical with the pattern determined by his confrères in various other fields of paleontological research; that it has stood the test of a century of criticism as to its theoretical as well as practical soundness—he gets to feel that the phylogenetic tree as the true pattern of the history and evolution of life is a pretty fundamental and certain matter, that it has taken this form because, short of miracles, it could take no other. In so far as the record goes it definitely does take this form. Where the record is absent, we should assume the same pattern unless there is convincing evidence for a different interpretation of existing life.

Doctor Clark states, however, that this is not the case with other groups whose fossil record is at least partially known, and instances the cats and dogs as an example. Cats were cats and dogs were dogs; he tells us, and as far back as their history can be traced there is no approach between them. I do not know where he got this information, but it is quite incorrect.

Let us look for a moment at the facts. Cats are among the most highly specialized of the Carnivora in the reduction and special adaptation of the teeth, but are very generalized and much like the older extinct and more primitive living Carnivora in the limbs and feet. Dogs, on the other hand, have retained a comparatively primitive dentition, but have specialized considerably in the limbs and feet for swift running. Both have a high type of brain among the Carnivora, and a variety of minor special characters are found in one or both.

Now we can trace back the cats and dogs through a fairly complete series of stages to the Oligocene epoch of the Tertiary, and the dog ancestry is a pretty close series beyond that to the beginning of the Eocene, but little is known of the earlier ancestry of the cats. The Oligocene dogs are but little different in the teeth from their modern descendants, but the limbs have much more nearly the cat proportions, the feet have five toes, like cats, and the claws are partially retractile. The Oligocene cats on the other hand are much like modern cats in limbs and feet, but have more numerous and less specialized teeth.

When first found, these Oligocene ancestors were not recognized as cats and dogs, as the names of the earliest discoveries testify. *Cynodictis* (i.e., dog-toothed weasel), *Daphœnus* (devourer, i.e., glutton or wolverene) are now recognized as ancestors of the dogs, *Aelurogale* (i.e., cat-marten) and *Dinictis* (i.e., terrible weasel) as ancestors of the cats; but these relationships were not at all clear to the experts who first described them. Not until the intermediate series were discovered could the real affinities be demonstrated.



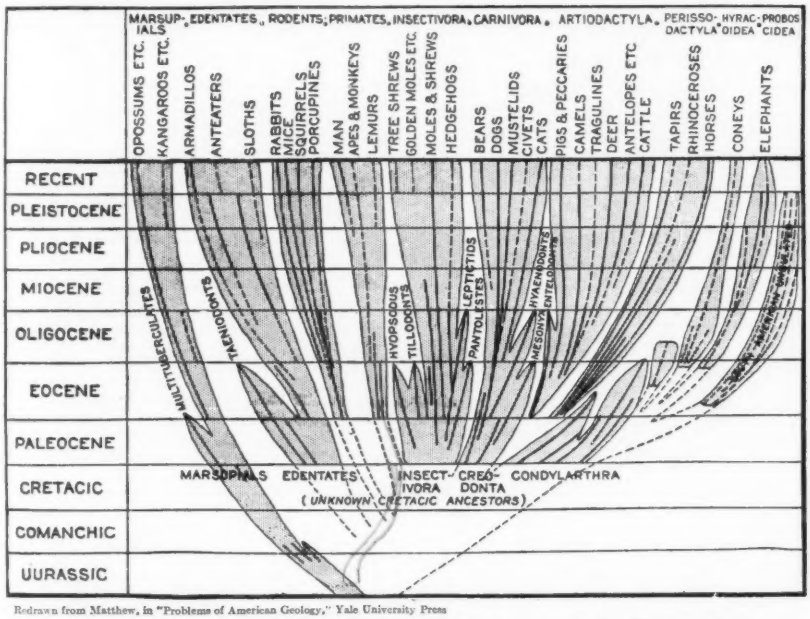
IT appears, therefore, that Doctor Clark is wholly mistaken in supposing that cats and dogs make no approach as we trace their ancestry back. They are already distinct in the Oligocene, but most of the wide differences that separate them today have not yet appeared. Could we trace the cats back through the Eocene, we should presumably find them gradually merging into a common ancestry with the dogs, which we can so trace, and whose Eocene ancestry is merged in exactly this fashion with that of mustelids (otters, minks, skunks, and so on) and bears and raccoons and civets. It is identically the same pattern as we have seen in the horses, tapirs and rhinoceroses, and goes step by step along with it in time. (See cut.)

I fully agree with Doctor Clark—and with Darwin—that the selection and differentiation of the various domesticated breeds of animals affords

the most important illustration of how natural selection has operated. But I can not at all agree with his statement that there are no intermediates between the principal breeds of dogs as he cites them, nor with his implication that they all appeared suddenly in their modern stage of specialization. Any dog-fancier or student of the history of the breeds of dogs could set him right on that better than I can, but I am sure from what I have read that the different breeds, while originating in part as sports, have been largely developed and modified through centuries of selection and inter-crossing. The whole subject of variation under domestication has been very thoroughly treated by Darwin and others, and its relationship to natural selection is largely affected by the fact that most of the breeds as at present developed, while useful to man for certain purposes, would have but little chance for survival in nature. Some of them are probably based upon wild species, and would doubtless revert to type in time if they ran wild; but there is no reason to suppose that these wild species were evolved in any but the normal manner.

Concerning the evolution of man, Doctor Clark does not say much, but again I must take exception to some of his statements. He emphasizes the distinctness between man and the great apes "in every bone of the skeleton," and assures us that "the differences seem too great to have ever been bridged by intermediate types," and that "of all the fossils that have been found not a single one represents indubitably a missing link."

I do not know how far he is acquainted with the demonstration made by Huxley and confirmed by many subsequent writers, that the anatomical gap between man and the anthropoids is less than between these and the monkeys, less than between monkeys and lemurs, and that the differences are very largely superficial adaptations. But if by a missing link he means any intermediate stage or stages, I can not see how he would explain away the characters of the Neandertal man, which differs from modern man in a dozen or more obvious distinctive characters of teeth, skull, jaws, and skeleton, every one of them except his "taurodonty" constituting a definite approach to the anthropoid apes. Or the characters of the recently discovered Peking man and of the Piltdown man, both early Pleistocene, older than the Neandertal man, and making a further approach in most, although not all, characters to the anthropoids—the Peking man having more human teeth but a very ape-like jaw, the Piltdown man so apelike both in teeth and jaw that some authorities have insisted that the jaw could not have belonged with the skull, which is still dominantly human.



Redrawn from Matthew, in "Problems of American Geology," Yale University Press

How the mammals deployed during the Tertiary period. Despite the indicated gaps a careful study of the subject will point to a common ancestor of all the mammals. Note under "Carnivora" (at the top of the cut, just to the right of the center) the dog-cat ancestry mentioned by the author

Or of the Taungs skull from South Africa, related to the chimpanzee, but making an unmistakably nearer approach towards the human type. Or the classic *Pithecanthropus* of Java, which has a skull-cap and brain construction about half-way between ape and man.

If these are not intermediate stages, what are they? If Doctor Clark means that they are not "missing links" because they are no longer missing, I quite agree, and only wish that more could be discovered, and that all of them were as fully known as the Neandertal man is today, thanks to Marcellin Boule.

Again Doctor Clark makes a great deal of family life and the dependence of women, of articulate speech and the use of tools and fire, as fundamental distinctions between man and all other animals. But there is a pretty wide difference between man and man in these and most other distinctions, physical or mental. It is not especially rare among primitive races of man, or civilized races under primitive conditions, for a woman to bear and rear offspring without the help of man; nor do I think it is wholly the custom among apes, as it certainly is not among various other animals. The great apes are not "promiscuous," nor indeed the monkeys, although they are not monogamous; and various degrees between polygamy and promiscuity are not particularly uncommon among the lower races of man. Is the difference between an animal that has a dozen or more sounds expressive of definite concepts or feelings and a savage who has at most a couple of hundred, so very much greater than between the latter and a man of science with a vocabulary that runs into the tens of thousands?

THESE are all matters of degree, as are all the distinctions seen by science between man and animals. If indeed Doctor Clark had declared for the presence of a soul, as do the orthodox, as the fundamental and impassable gulf between man and animals, I would have nothing to say. As a man of science I know nothing one way or the other about souls, and my religious convictions I do not think it necessary to express in the SCIENTIFIC AMERICAN. But so far as scientific evidence and the fossil record are concerned, it appears to me that it fits very clearly and convincingly into our pattern of evolution, and that the descent of man and the anthropoid apes from a common ancestry is far better proved than many things that we implicitly believe. There is, I am well aware, a divergence of opinion among eminent scientists as to how far back that common ancestry should be placed and just what relationship should be assigned to the apes.

Turning now to what Doctor Clark has called *eogenesis*, that is, the origin of the great branches or phyla of animal life, as he fully recognizes, the origin of these great branches must be carried back toward or beyond the beginnings of the geologic record, while our fossil record extends back only through the later half of that record. The rest is inference. If it were true, as he gives us to understand that it is, that each great branch appears in the Cambrian period as clearly distinct, as fully differentiated and specialized as

it is today, then it would be a reasonable inference, although far from being necessarily or even probably true, that that degree of distinctness continued on back indefinitely. The alternate view would be that, having in the course of evolution attained the full degree of specialization that was of any net advantage to the organism, natural selection would cease to impel it any further and it would remain unchanged in the essentials of its machinery so long as it remained in the environment to which it was now completely adapted. If the environment changed, further changes might come about, not necessarily in the direction of progress. Otherwise it might well remain substantially unaltered from the Cambrian or a much earlier period, down to the present day.

I believe that that is pretty largely true of the lower groups of invertebrates, the groups with which Doctor Clark is especially familiar. Cambrian protozoa, Cambrian sponges and jellyfish, are much like their modern relatives, probably just about as much specialized *so far as the hard parts show*. The same is at least partly true of the echinoderms (star fishes, sea urchins, and so on). Whether it is true of worms nobody really knows. But when we get into the higher groups, the molluscs and arthropods (spiders, crabs, insects, and so on), and especially the vertebrates, it is very far from true. The Paleozoic era molluscs or arthropods do not have nearly the degree of diversity and specialization that can be found among the higher modern molluscs. The earliest insects have not taken on the important specializations that characterize the higher groups of the class; they compare only to the lower and more primitive groups. And the vertebrates, when they make their first appearance as ostracoderms in the Paleozoic era, have, as Stensio has shown, all of their essential organs in a more primitive stage of imperfect evolution as compared with even the most primitive of modern fishes, and are a long way behind the higher vertebrates in the perfection and specialization of their mechanism.

IT is quite true, then, that the great branches of animal life were already distinct in the Cambrian period, with the exception probably of the Vertebrata. It is by no means the case that they are as diverse from each other or as diversified within each group as they are today. On the contrary, the most advanced and specialized groups of the early Paleozoic era find their nearest relatives in the more primitive and generalized groups of today. Again taking our phylogenetic tree as an illustration, we may say that while most of the main boughs were already distinct when the tree was half-grown, and, while some of the twigs of different boughs today may be as near to each other as any in these branches were in the Cambrian period half-way stage of growth, yet the boughs as a whole have grown farther apart, are more fundamentally separate and distinct, as well as broader in scope. It is therefore altogether erroneous to conclude that the relationships between the branches have undergone no change at all since the Cambrian.

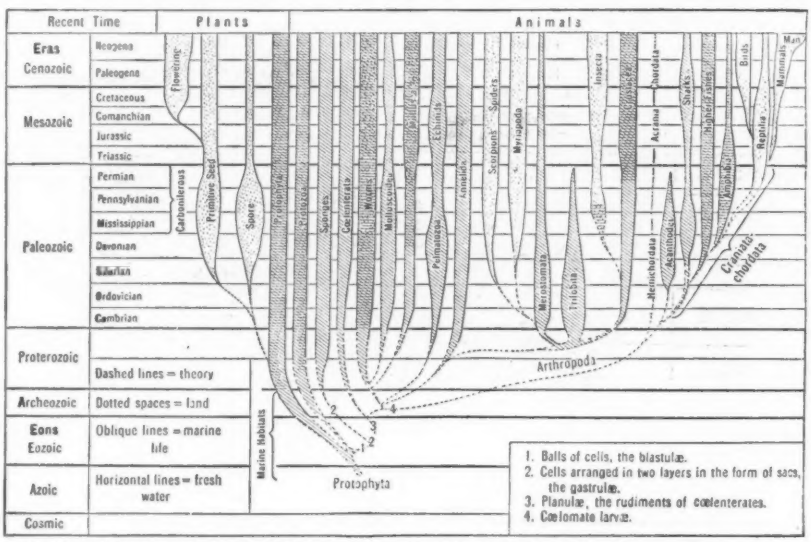
Our picture of the Cambrian tree of life is incomplete and sketchy, it is true. It is only the hard parts of these animals that are preserved to us (there are a few rare and partial exceptions), comparatively simple in structure in these lower types, and frequently of more or less doubtful position. They are identified chiefly through their likeness to corresponding hard parts of later and better known or surviving types. For the most part we do not know whether the far more important and complex soft parts were like those of modern forms. It is in this way that they are "at once recognized"—when they are—for the history of paleontology shows many decades of dispute over the real relationship of some of the problematic fossils.

At all events, we can hardly question that the tree has grown enormously since the Cambrian, and in view of that fact I see no reason to adopt Doctor Clark's thesis that it came suddenly into existence at some moment in pre-Cambrian time. It is too much like the Indian juggler's mango tree trick, and, while the pre-Cambrian tree is hidden under a basket, under the cloak of our utter ignorance, I do not believe that such a miracle happened, or that its growth was otherwise than according to the natural processes seen in the subsequent record of the history of life.

Nevertheless there is, and will always remain, much obscurity as to the origin and early development of life on the earth, and a wide latitude for reasonable hypothesis as to its precise cause and course. I see no reason to adopt Clark's view that all the different branches originated at one time. Certainly the vertebrates must be excluded from any such hypothesis, for Stensio's studies have shown that the ostracoderms, although vertebrates, have the vertebrate organs and characters in a very rudimentary stage of development and make a very marked and significant approach to certain invertebrate groups.

IT is by no means clear that the other branches have a common origin. It is quite conceivable, and has been argued for half a century or more, that each branch may have evolved separately from inanimate matter at different times, passing through a similar but distinct one-celled stage, the identity of cell-structure in all modern animals being due to such fundamental laws of matter as make one quartz crystal like another in form and structure and composition and relationship of its component molecules. We pass here into the rarefied atmosphere of speculative hypothesis, far removed from the solid grounds of fact and record on which the paleontologist builds his lowly but tolerably permanent habitations.

And I confess that these higher flights, while interesting to watch, do not tempt me to emulation. My air-minded friends may scale the heights of fancy as they will. Those of us whose temperament is more cautious and conservative will content ourselves with admiring their ingenuity and daring, and hope that they will not crash.



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The phylogenetic tree, the true pattern of the history and evolution of life. The heavy horizontal line just below the center marks the "Cambrian period"

The first step in making a foot brace is a plaster impression, forming a mold for casting

A plaster duplicate of the crippled foot is cast in the mold, trimmed, and a piece of metal is cut to shape for forging

In this picturesque forge shop the iron plates are made to conform to the plaster replica of the foot made in the mold

Making a plaster jacket for the back. From this cast a mold is made which serves as a base on which to build a corrective corset

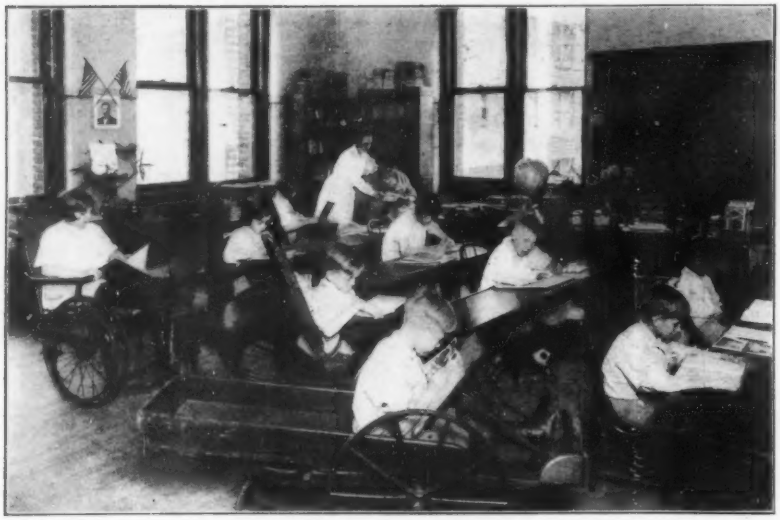
Modern Rehabilitation of the Cripple

By ALBERT A. HOPKINS

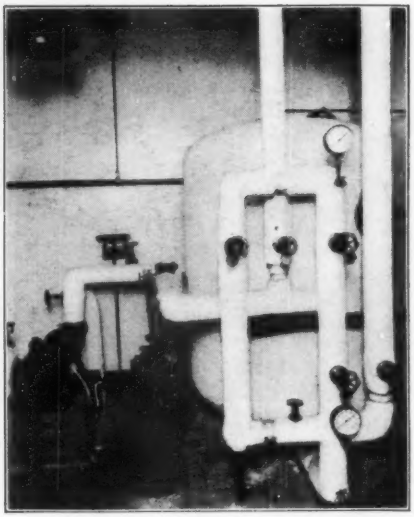
UNDER the shadow of one of New York's great home developments—Tudor City on 42nd Street—is the New York Society for the Relief of the Ruptured and Crippled, which devotes itself to orthopedic relief by surgery or otherwise. In the last quarter century great advances have been made in the treatment of cripples. There was a time when the patient was dismissed with a properly fitted truss or brace. Now the tendency is to try to relieve the sufferer by surgery, or by mechanical, electrical, or therapeutic treatments. We shall here consider only the non-surgical phases.

The hospital operates a vast clinic where treatment is free to the poor, and those who can pay are asked as little as 25 cents to one dollar. Those who are better off are generally glad to pay five dollars. The hospital originally occupied the plot on which the Commodore Hotel was built. The Grand Central Station improvements called for a new hotel and the hospital was moved a few blocks to the eastward into the heart of an extremely congested district.

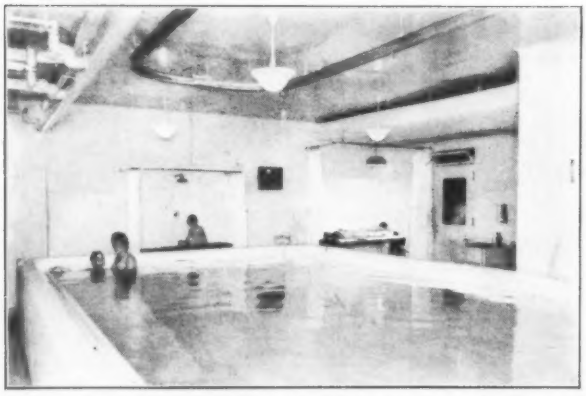
Orthopedic surgery deals with the rectification of congenital and acquired deformities, particularly those of the



Children often have to remain long periods in the hospital for operations; a school is provided so that their mental growth will not be retarded

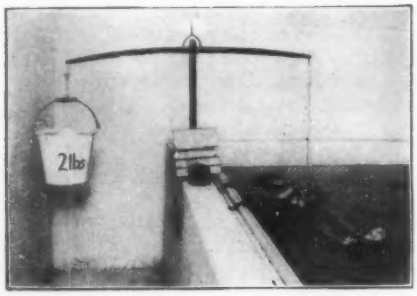


The water for the pool is filtered, sterilized with ultra-violet rays, and warmed to the desired point



Note that the pool is not sunk but is raised. The trolley assists in exercising the patients in the water

The hospital patient can rest his torso on the submerged table and can freely exercise his legs in the pool

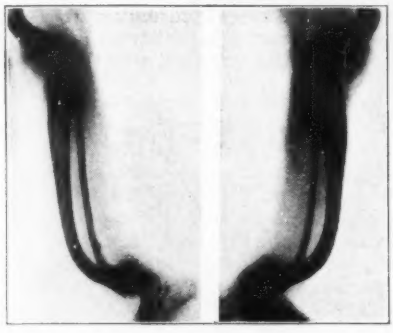


The pool being used to demonstrate the "principle of Archimedes"; the Greek philosopher discovered the exact law which governs the loss of weight of a body in a liquid. The principle may be stated as follows: any body immersed in a liquid will lose a weight equal to the weight of the displaced liquid

The patient is suspended from the overhead trolley that encircles the pool. He can move his limbs freely without fear of sinking

limbs and spine. It is a most interesting phase of surgery. Often as many as eight or ten operations are necessary before the patient is restored to society able to engage in life's struggle on a fairly equitable basis, handicapped perhaps, but vastly improved. This all takes time and it sometimes requires over a year to "make over" a child. A hospital of this kind is not a particularly cheerful place to visit, but on leaving you are filled with thankfulness that your limbs and your children's limbs are straight and that you have never been stricken by the dread infantile paralysis.

We cannot here go into the technique of orthopedic surgery with its power-driven bone tools, bone dowels, the reconstruction of bone ends and the

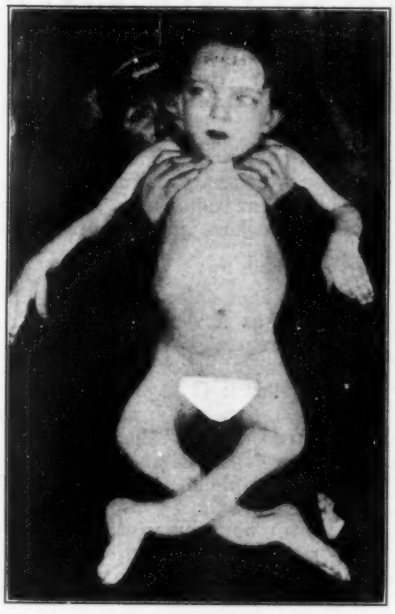


introduction of transplanted or living tissue between the bone ends to secure movement, and dozens of other complicated and interesting operations. They can hardly be explained to the lay reader, so we will pass on to some of the other methods of treatment.

Correctional devices have always proved of great value with or without surgical relief. Foot correction occupies an important part of the work of this hospital. A cast is made of the foot and this serves as a mold in which to cast in plaster of Paris a replica of the deformed foot. This cast serves as a pattern to which a metal plate is conformed. This flat plate is cut out to form by a sheet metal working machine or nibbler. It is then contoured by blacksmiths who give a picturesque air to the shop with their time honored anvils.

IN spinal deformities a cast is taken from the patient. A plaster jacket is made on the patient by winding wet crinoline bandages in which plaster of Paris is impregnated. This drys in a few minutes and becomes very hard. If a corset is desired this jacket is slit down the front, removed, and used as a pattern.

Various devices are employed for exercising the flabby and unused muscles and even used to help teach the patient to walk once more. Therapeutic lights of all types are em-



Above: **A victim of rickets so deformed that he has never walked and his legs could not be untwisted.** ***Left:*** **X rays before operation**

ployed and hydro-therapeutic treatments of all kinds are given. The therapeutic pool gives much relief from the effects of infantile paralysis, arthritis, congenital hip disease, and other diseases paralyzing the muscles. In effect, the treatment in the pool is similar to that given at Warm Springs, Georgia, which has been so strongly advocated by Governor Franklin D. Roosevelt of New York State, also a sufferer.

The pool might be termed an under-

Above: **The patient after operations had restored health. He can play, and his mentality has improved.** ***Right:*** **X rays after operation**

water gymnasium but this would not be strictly correct. The principle is one of the most elemental in physics. Since a body submerged in water loses weight in direct proportion to that of the displaced water, patients assisted by this buoyancy are able to perform exercises while in the water, which they could not possibly do when not submerged. Dr. K. G. Hansson, of the hospital staff, conceived the idea in 1914 of indoor pools of heated water for therapeutic purposes and such pools now exist in New York City, Port Jefferson, Long Island, and in Los Angeles.

The patient is given a shower and then climbs up into the pool, which is waist-high and not sunk as is usual. The water is filtered and sterilized with ultra-violet rays. The pool is 26 feet long, 12 feet wide, and the depth varies from two to four feet. The tiles are of the "non-skid" variety to protect those who, at best, have difficulty in walking.

TWO of our illustrations show the "principle of Archimedes" worked out in actual practice. We also show a table submerged in the pool so that the patient may rest the torso on it and exercise the limbs.

Through the courtesy of Dr. Armitage Whitman of the hospital staff, we are enabled to present pictures of a boy whose whole life was changed by surgery. A social worker connected with another hospital visited a recently discharged patient who was a janitress in a tenement. There were no windows in the apartment and here the social worker found a child sitting with his legs crossed—tailor fashion, as in one of the pictures. He was a victim of rickets caused by lack of sunshine, proper food, and fresh air. His legs were consequently so deformed that they could not be untwisted. He had never walked and his feet had never touched the gound. The boy was removed to the Hospital for the Ruptured and Crippled and after four operations at proper intervals his deformities were corrected and he now walks normally and his mentality is improved.

Basic Patents in Evolution—II

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University. Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History. Member of the National Academy of Sciences

IN Part I of this article we saw that the striped muscle fiber, a living elastic thread that contracts when stimulated by its minute nerve fiber, was the first "basic patent" or primary invention of the complex locomotor apparatus of vertebrates. The second step was the grouping of these muscle fibers into zigzag muscle segments arranged in tandem along either side of the body. Whatever may have been the still earlier stages, it is certain that at a very early period the vertebrate body as a whole had been modeled into some kind of "stream-line" form, with a blunt, rounded head and flowing contours dwindling to the rudder-like tail. This discovery of the advantages of the stream-line body-form, both for forward locomotion and for heading up stream, may well be reckoned as the third "basic patent," although of course the reader will understand that in nature such changes are more or less continuous and more or less simultaneous, so that it is arbitrary to assign a numerical order to certain changes which may more properly be considered as details in a drift or movement whose general direction is known.

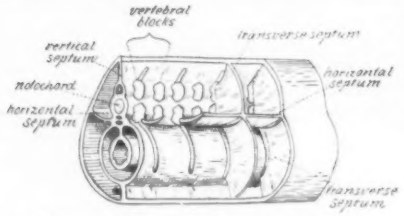


Figure 6. **The basic patent of the vertebrate skeleton. The skeletal pieces (either cartilage or bone) arise as strengthening rods and blocks at the intersections of the longitudinal transverse and horizontal septa. After Goodrich, from "A Treatise on Zoology" (Ed., E. Ray Lankester), Part IX**

IN this connection it may be regarded as a well-established fact that the general course of evolution in the vertebrates from fish to man has been as follows: (1) a primitive chordate stage, typified broadly by the fossil ostracoderms of the Silurian age; (2) an early shark-like stage, with a relatively simple skeleton; (3) a lobe-finned stage of the Devonian age, provided with both lungs and gills and with paired paddles corresponding to our arms and legs; (4) an early land-living stage, typified by the earliest known amphibians of the Coal Measures; (5) an early lizard-like stage, known in the oldest fossil reptiles; (6) the stage of the mammal-like reptiles of the Permian and Triassic ages; (7) the early shrew-like mammals of the Triassic and Jurassic periods; (8) the first of the tree-living primates at the beginning of the Eocene epoch; thence (9) to the remotely prehuman stock that also gave rise to the Old World monkeys, perhaps at the close of Eocene times; (10) the predecessors of the anthropoid apes, some of the earliest of this lot giving rise to (11) the human line, perhaps in Miocene times.

Among other basic patents which were essential for the forward propulsion of an undulating stream-line body was the possession of a more or less elastic axial or functional backbone (Figure 6). In the first stage of its development this axis was unjointed and continuous and appeared in the form of the notochord. Later the notochord became surrounded by small blocks, clustering around the connective tissue partitions between the muscle segments, and still later these blocks combined in various ways to compose the different kinds of vertebræ that are found in amphibians, on the one hand, and in reptiles, birds and mammals, on the other.

At an early period steering was effected, as we have seen, by keel-like outgrowths from the body-wall, some of which eventually gave rise to the pectoral and pelvic paddles, which correspond to our arms and legs. At first these were supported only by rod-like pieces of cartilage that were laid down between the connective tissue mem-

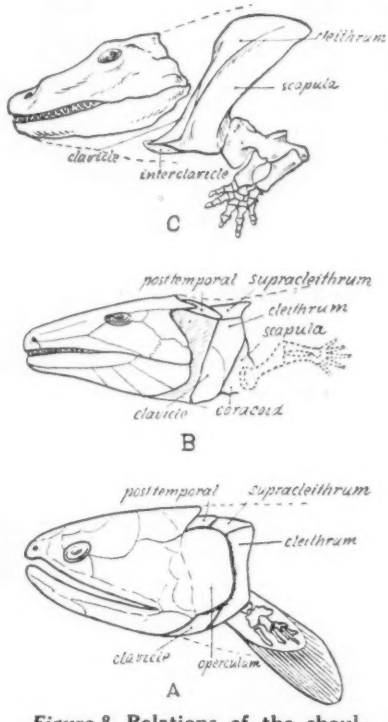


Figure 8. **Relations of the shoulder-girdle to the skull in lobe-finned fishes and early tetrapods. (A) Lobe-finned ganoid (*Eusthenopteron*) from the Devonian period, with the pectoral girdle immediately behind the gill cover (operculum) and fastened to the skull by the post-temporal. (B) Most primitive known amphibian (*Eogyrinus*) from the Lower Carboniferous of England with the pectoral girdle still fastened to the skull by means of the post-temporal. (C) Typical primitive tetrapod (*Eryops*) from the Permian period of Texas, showing shoulder-girdle free from skull, although in life it was tied to it by muscles. Data for A from Bryant 1919; B from Watson 1924; C from Miner 1925**

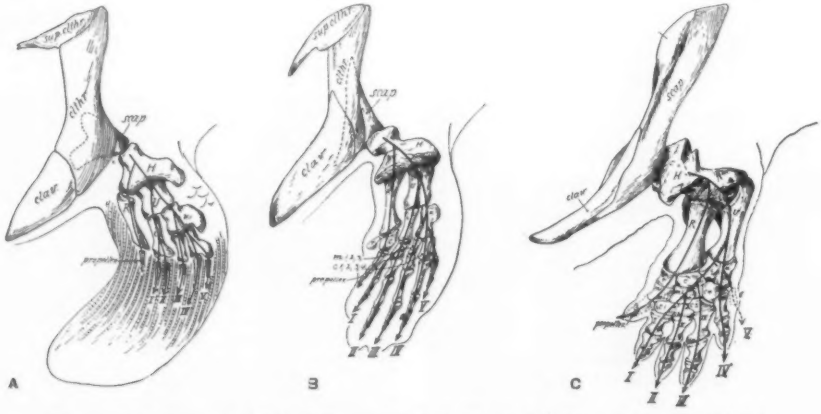


Figure 7. **Left pectoral paddle and left half of shoulder-girdle in (A) lobe-finned fish, (B) hypothetical intermediate form and (C) early amphibian. After Gregory. In each view the limb is shown supporting the body weight**

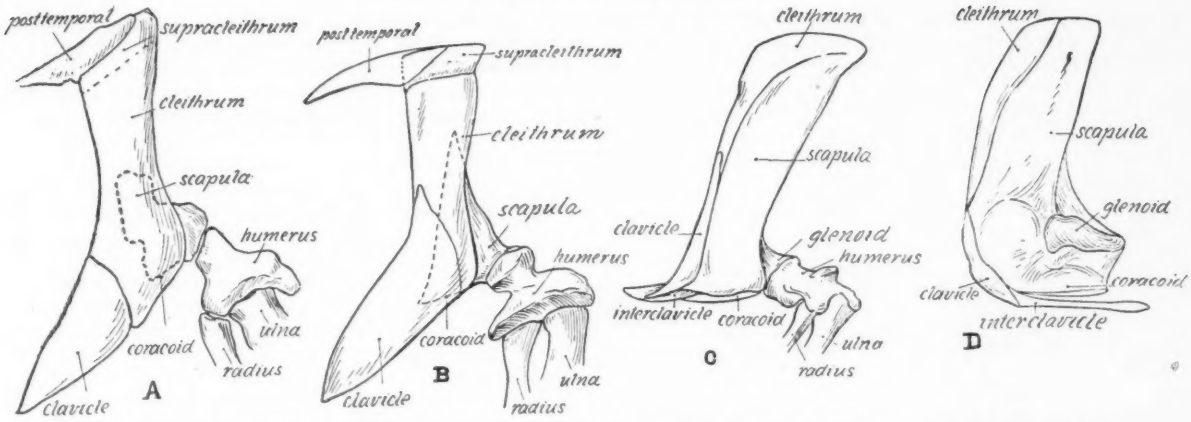


Figure 9. **Four stages in the evolution of the shoulder-girdle. (A) Left half of shoulder-girdle of lobe-finned fish (*Eusthenopteron*) showing the primary shoulder-girdle (scapulo-coracoid) behind and mostly on the inner side of the secondary, outer or dermal girdle (clavicle, cleithrum, etc.). (B) Left half of shoulder-girdle of very primitive amphibian (*Eogyrinus*), showing initial enlargement of the inner girdle, (scapulo-coracoid), but with the entire outer girdle still functional. Data from D. M. S. Watson. (C) Typical early amphibian (*Eryops*), showing great enlargement of the inner girdle (especially the scapula), reduction of the clavicle and cleithrum, and disappearance of the supra-clavicle and post-temporal plates. (D) Early primitive reptile (*Diadectes*), showing enlarged primary girdle (scapulo-coracoid) and reduced outer or secondary girdle (cleithrum, clavicle, interclavicle). The coracoid plate is undivided. Details chiefly from Gregory, 1928**

branes that surrounded adjacent muscle segments. In the sharks the pectoral paddles are supported by a fan-like system of cartilaginous rods and basal blocks, which as a whole correspond to the skeleton of our hands and arms. By the time of the lobe-finned fishes of the Devonian period (Figure 7, A,) the skeleton of these pectoral paddles had begun to foreshadow the "tetrapod" or four-footed, land-living type, but they were still unable to support the full weight of the body on land. When at last certain of these air-breathing, lobe-finned fishes ventured to crawl out of the foul pools, in which in the dry season they were liable to suffocation, their pectoral paddles were drastically remodelled into the five-fingered tetrapod type (Figure 7, C) which even man retains in a somewhat modified form.

In a crawling amphibian or crocodile or in a running mammal, after the body is lifted up by the straightening of the limbs it falls forward, passing over an arc the radius of which is measured by the distance from the shoulder-joint to the base of the fingers. The pectoral and pelvic girdles are essential structures not only in transmitting the thrusts caused by the straightening of the limbs, but also in acting as slings for the support of the body. The pectoral girdle in front view is a U-shaped sling, consisting on each side of an inner core, the scapulo-coracoid arch, and an outer layer of bony sheathing plates, found in all fishes above the shark grade as well as in the earliest land-living animals up to the mammal-like reptiles.

In the air-breathing, lobe-finned fishes of the Devonian period the shoulder-girdle was a crescent-shaped structure that separated the gill-chamber in front from the muscular flanks of the body behind it (Figure 8, A). It consisted of two layers, an inner or primary shoulder-girdle, which

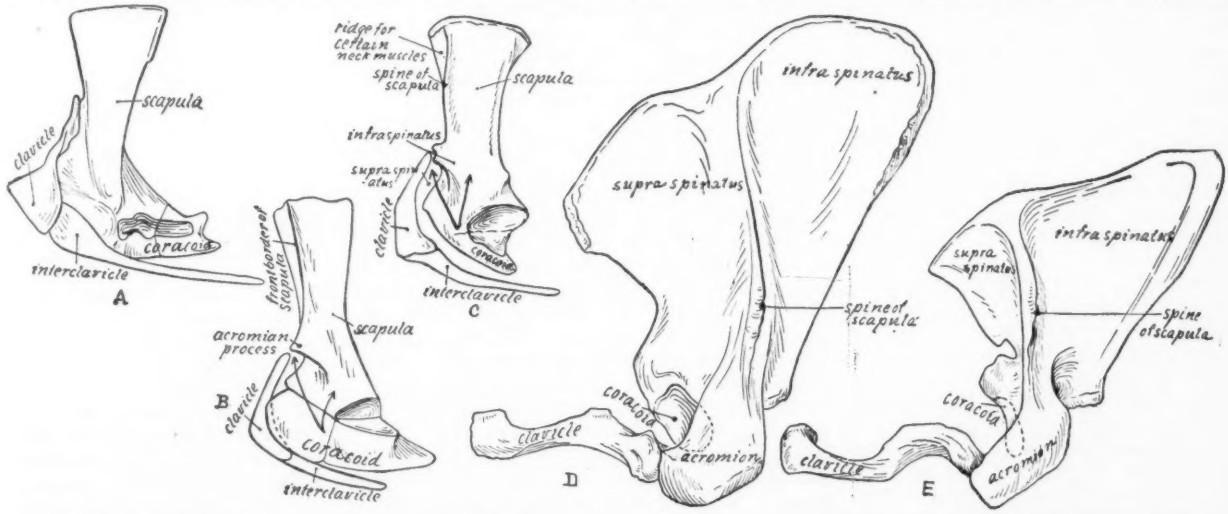


Figure 10. **Further history of the shoulder-girdle. (A) Typical early reptilian type, after the loss of the cleithrum. The coracoid plate is now subdivided by a vertical suture into two parts, of which the posterior one later gives rise to the coracoid process of mammals. (B) First phase of the mammal-like reptile stage, in which the front border of the scapula is reflected outward to form the "spine of the scapula." The arrows show the directions of the two upwardly-growing divisions of the supracoracoid muscle, which give rise to the supraspinatus and infraspinatus muscles of mammals. (C) Second phase of the mammal-like reptile stage, showing further progress toward the mammalian condition, in which the "acromion" projects from the spine of the scapula and the coracoid plate is reduced in size. (D) Shoulder-girdle of the gorilla (left half), showing complete agreement with that of man except for minor differences in the proportional size of certain parts. (E) Shoulder-girdle of man (left half). Of the original two-layered girdle the clavicle represents the outer or dermal girdle, while the scapula represents the primary girdle. The coracoid is reduced to a hook. After Gregory, 1928**

was more or less crescent-shaped, with the concave side directed forward, and a surface layer of bony plates following the same general direction and fastened above to the hinder outer corner of the skull. At first the outer or sheathing plates of the pectoral girdle predominated but when the weight of the body came to rest on the bent pectoral paddle, the stresses on the inner or primary shoulder-girdle increased, so that the scapular blade (Figure 9) grew upward and finally (Figure 10) became the dominant member of the series.

In the course of many millions of years the outer dermal girdle as a whole gradually lost its functional importance, so that in the higher mammals several of its plates, namely the interclavicle and the cleithra of either side, have disappeared entirely. In the primates, including man (Figure 10, D, E) only the clavicles or collar bones remain as souvenirs of the outer or dermal shoulder-girdle; this was because the ancestors of man were tree-living forms in which the clavicles were important in suspending the weight of the body from the arms.

Meanwhile the inner or primary shoulder-girdle has likewise undergone many important changes (Figure 9). In the lobe-finned fishes (Figure 9, A) its lower prong, the coracoid, was not large. In the early amphibians it has broadened out into a large semicircular plate. In the mammal-like reptiles (Figure 10, C) it finally diminishes in size, while the scapular blade above it meanwhile becomes dominant; in the mammals (Figure 10, D) the coracoid undergoes progressive reduction and finally (Figure 10, E) dwindles into the coracoid process of the human scapula.

THE scapular blade has also been greatly modified and its history furnishes a beautiful example of the fact that during the course both of individual growth and of evolution, bone is not a rigid substance but responds to the changing forces around it by laying down "trabeculæ," or tracts of bone cells, in directions that stiffen the bone against the stresses developed within it. Thus the form of the bone changes from within in adjustment to external stimuli. In the lobe-finned fishes (Figure 9, A) the scapula is relatively small, but when the pectoral paddle had to support the weight of the body on the ground the stresses that were developed in it increased and it enlarged accordingly (Figure 9, B, C). At first its function was chiefly for the anchorage of the muscles that suspend the body, including those that run either downward and backward to the ribs or downward and forward to the sides of the neck vertebræ. The inner side of the scapula also serves as the anchor for a part of the subscapular muscle which tended to draw the humerus inward; its outer surface (Figure 11) was partly covered by the great deltoid muscle running downward to the outer

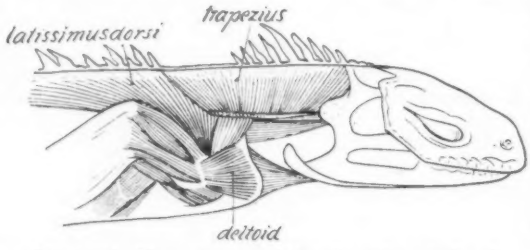


Figure 11. **Musculature of the shoulder-girdle of a primitive reptile (*Sphenodon*). From Gregory and Camp, 1918, after Fürbringer, 1900**

side of the humerus, while its upper border served for the origin of muscles that passed inward to the top of the backbone. Thus the scapula or upper part of the primary shoulder-girdle becomes the platform for many important muscles that transmit the thrust of the backwardly extended humerus upward and forward, or prevent the collapse of the scapula upon the humerus, or hold up the body when the opposite limb is lifted from the ground.

THE subsequent changes in the scapula were dependent upon the change from crawling, with the elbows sprawling outward, to running, with the hands under the body and the elbows drawn in to the sides (Figure 12). When this happened, certain muscles on the outer side of the coracoid plate found themselves in a disadvantageous position and they accordingly gradually shifted upward (Figure 10, B, C), invading the outer face of the scapula from below and giving rise to the supra- and infraspinatus muscles of mammals. These muscles assist in moving the humerus back and forth but they are even more essential in cooperating with the subscapular muscles in preventing the collapse of the scapula upon the humerus. However, the original front border of the scapula had already been curled outward (Figure 10, B, C) by the stress of surrounding muscle and had given rise to the so-called "spine of the scapula" of mammals. Thus when the invading muscle from the supracoracoid mass grew upward, the rear fork passed behind the spine of the scapula and occupied the post-spinous fossa, while the front fork passed in front of this spine.

It has frequently been observed by all students of the skeleton of mammals that the presence of muscles and their tendinous sheaths frequently cause the upgrowth of ridges and crests from the bone that supports them. Consequently when the front fork of the upgrowing supracoracoid muscle found itself pressing against the scapula, it was soon able to evoke a supporting crest, which finally gave rise to all that part of the mammalian scapula which lies in front of the scapular spine. Hence we, in common with other mammals, owe the front part of our shoulder-blade to our remote ancestors, the immediate successors of the mammal-like reptiles, who first developed a ridge or crest in front of the spine of the scapula for the support of an upwardly prolonged slip of the old supracoracoid muscles.

When the limbs were drawn in at the sides (Figure 12, B) the joint between the humerus and the scapula was pulled outward and the coracoids were drawn out into narrow rods; then these lost their attachment to the breastbone or sternum and dwindled away into the hook-like coracoid process. This was retained only because it gave anchorage to the powerful biceps and coraco-brachialis muscles which flex the forearm.

In brief, the pectoral girdle of the

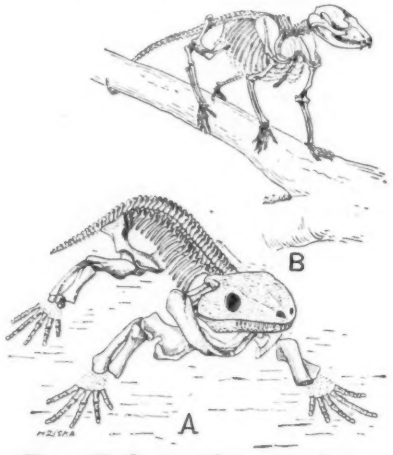


Figure 12. **Contrast between primitive reptile (A), with sprawling limbs and typical mammal (B), with limbs drawn in at the sides**

ancestral fish served as the rear wall of the gill-chamber and as the anchorage for the pectoral paddles and body muscles. It consisted of an inner and an outer series of plates. Under the changed conditions of locomotion on land the inner or deep parts of the pectoral girdle gained the ascendancy and the outer plates finally became greatly reduced. Man inherits his shoulder-blade, or scapula, together with his now vestigial coracoid, from the inner series of the pectoral girdle of the fish; his clavicle, or collar-bones, represents its dermal plates.

Thus new advances require the sacrifice of old devices and the working out of new basic patents.

(To be concluded)

A Fish Factory At Sea*

THE outfitting of a ship, formerly in operation in the Orient, as a floating fish factory, has just been completed in England and she has left for a cruise in the waters off southwest Africa. The *Seapro*, as she was renamed, is provided for dealing with the many classes of fish in that locality and a fleet of motor boats for doing the actual fishing. These boats, it is anticipated, will bring to the parent ship from 60 to 100 tons of fish every day. Some of the fish that will be utilized are fit only for conversion into cattle, pig, and poultry feed; some are valuable for their oil content; others have livers that provide a valuable medicinal oil; and some are worth putting in cold storage for sale at a convenient market.

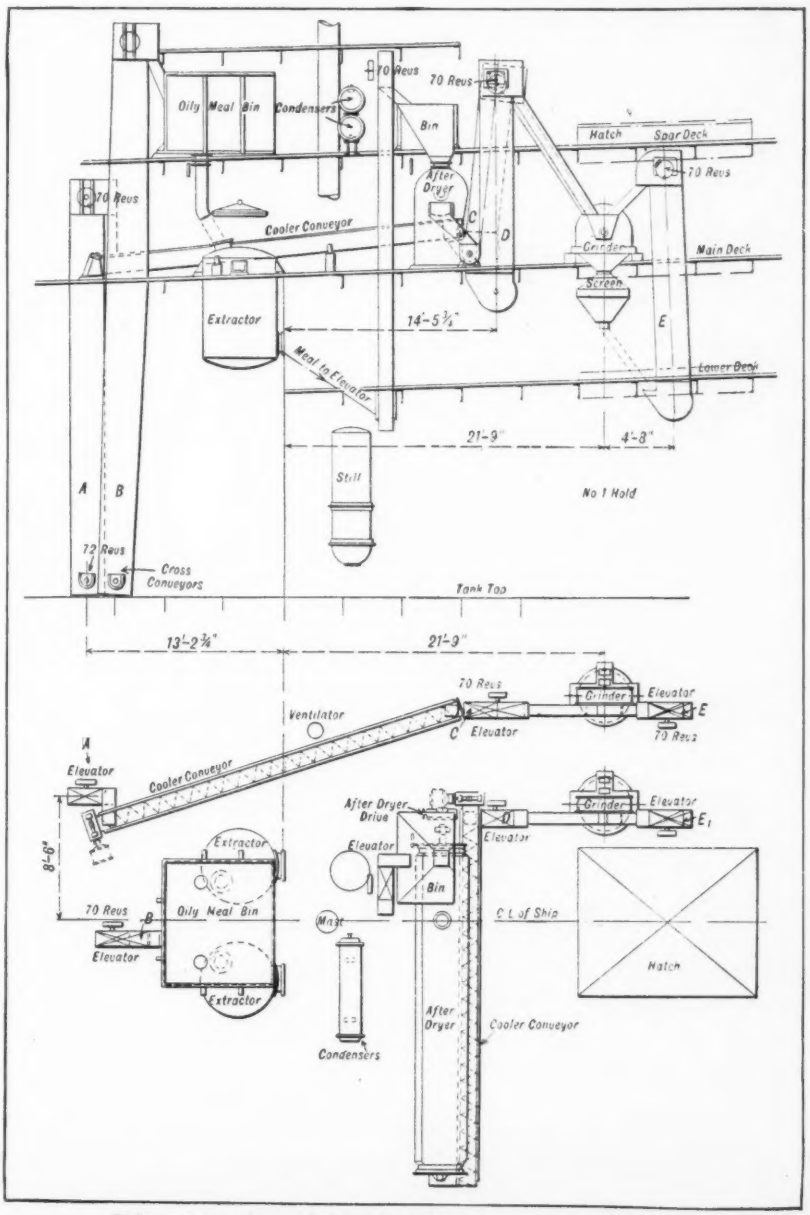
In such an enterprise as that of the *Seapro*, one of the first matters to be borne in mind is that the average content of water in fish is from 70 to 75 percent and that the ship must not be encumbered with so much valueless material. As a consequence, the greater part of the catch must be passed through dryers to drive off this moisture.

The coarser kinds of fish will be hoisted on deck from the fishing boats and dumped into hacking machines, one on each side of the vessel 'tween decks. These machines comprise two pairs of rolls made up of a series of toothed plates. The rolls rotate at different speeds and tear the fish into small pieces. The hacked material is then passed through a sterilizing chamber where the albumen is coagulated and any noxious bacteria killed by being subjected to steam. Then it goes into the drying machines, one of which is on each side of the ship.

THE drying is done in four parallel cylinders which are steam-jacketed. In the drying process, large quantities of steam are driven off and this contains a certain proportion of vapor of an offensive nature. This steam is, therefore, collected and passed through a series of three condensers which are cooled by circulated sea water. The condensate is discharged overboard. There remains a small amount of uncondensable gas which must be done away with, so this is sent up the boiler funnel for complete burning.

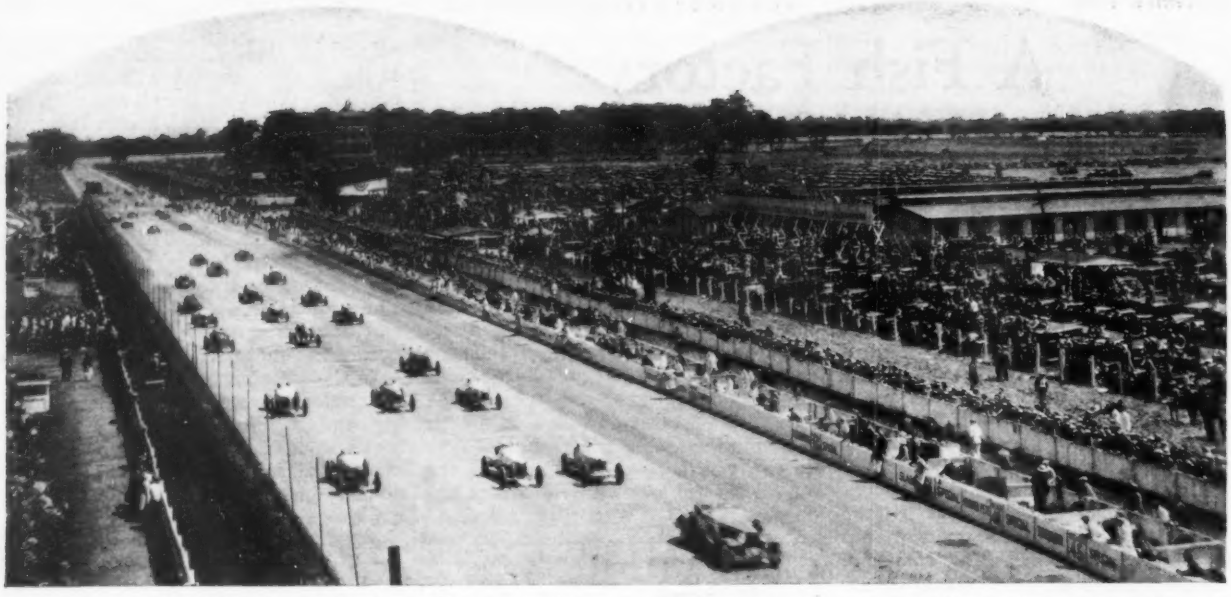
From the dryers, the meal is discharged into elevators, one of which is for "white" fish and one for oily fish. The white fish meal goes up elevator A—see diagram—to a cooler, then through a magnetic separator for taking out any scrap metal, into a grinder, and finally into bags ready for the market. The oily fish meal goes up elevator B into a large bin on the spar deck, from which it drops into one of two oil extractors, or digesters, on the deck below. Trichlorethylene, which is non-inflammable and recoverable in its entirety, is used for dissolving the oil. After the first wash of solvent has become saturated with oil, it is drained off and distilled. The condensers shown in the diagram condense the vaporized solvent. When all the oil has been recovered from the meal, steam is introduced into the extractors to recover any remaining solvent. The oil-free meal is then passed through the same process of grinding and separation as the white fish meal. The fish oil that has been extracted is pumped from the evaporator into tanks or barrels. The operations are all automatic, the machinery and conveyors being driven by electric motors.

In the after part of the ship there is a complete plant for making tins, boiling and canning such sea foods as crayfish; and another plant for boiling out the oil of fish livers. The refrigerating plant for carrying fine food fish to market is of normal design.



Side and top views of the principal equipment on the *Seapro*

*Abstracted, by permission, from *The Engineer*, London. Illustration courtesy *The Engineer*



The start of the 1930 Indianapolis race. The cars in this, the first lap, are being paced by a stock Cord front-drive car. This lap is not a part of the race but is run only to bring the cars across the starting line at 75 miles an hour

Racing Cars of 1930

By WILLIAM F. STURM

A STUDY of the 1930 Indianapolis race is especially interesting in view of the greatly changed conditions under which the race was run. The race is run on a four-cornered track, 2½ miles around, and paved with vitrified brick. The four corners were built for a speed of only 90 miles an hour average for the lap. They are banked only 16.66 degrees for the first 50 feet from the lower edge of the track, and 36.66 degrees for the outer 10 feet—the rim—where cars never run except in case of a near smash with another car.

One thing that made for a good race this year—one easy on tires especially—was that the temperature at noon was 58 degrees, with a good breeze blowing, against the 87 degrees last year.

A resumé of the first five places in the race, with last year's average for each, follows:

First—Billy Arnold, Miller-Hartz, front drive, eight cylinders, 150.5 cubic inches displacement; 100.448 miles an hour (last year's average, 97.585).

Second—William Cantlon, Miller-Schofield, rear drive, four cylinders, 183 cubic inches displacement, 98.054 miles an hour (last year, 95.596).

Third—Louis Schneider, Seal Fast, rear drive, eight cylinders, 121 cubic inches displacement, 97.241 miles an hour (last year, 93.699).

Fourth—Louie Meyer, Sampson, rear drive, sixteen cylinders, 203 cubic inches displacement, 95.253 miles an hour (last year, 93.541).

Fifth—Bill Cummings, Duesenberg, rear drive, eight cylinders, 243.5 cubic inches displacement, 93.579 miles an hour (last year, 88.792).

SEVERAL matters rather definitely decided by the race were:

That the rules banning the supercharger and other so-called speed adjuncts were not destructive to the speed average of the race.

That stock cars, or modified stock cars, did not enter the race in as large numbers as expected.

That the highly specialized racing car is still supreme, winning, as it did, the first four positions; or, if we include the changed stock motor in fifth place, winning the first seven places.

That while these highly-specialized cars will continue to be built, the modified stock-car engine made a showing that warrants the belief that it will appear in next year's race in greater numbers.

A year ago the Indianapolis Motor Speedway Corporation issued a radically new set of rules for the 1930 race. For four years the drivers had been piloting 91½ cubic-inch racing cars equipped with centrifugal type superchargers and having one-man bodies. (See SCIENTIFIC AMERICAN, January, 1930.—*Editor.*)

The rules for this year's race provided for the abolition of the supercharger; limited carbureters to two; limited poppet valves to two per cylinder; raised the piston displacement limit to 366 cubic inches; and made mandatory the two-man body and a minimum weight limit of 1750 pounds, with the further provision that cars must weigh 7½ pounds per cubic inch of displacement.

The drivers naturally made a great outcry. Racing had not been especially good for several years and the new rules compelled the drivers to spend from 2000 dollars, which was the minimum price a new body with gas tanks could be built, to 10,000 dollars, or 15,000 dollars for a completely new car. The rules meant even more than that to the driver—they meant that the little 91½ cubic-inch cars were practically obsolete, since other tracks would, in the main, follow the Indianapolis rules.

A study of the entry list of the race shows that there were 10 four-cylinder, 2 six-cylinder, 23 eight-cylinder, and 2 sixteen-cylinder cars. It is an interesting note that the winning car was an eight-cylinder, built up and owned by Harry Hartz, but not driven by him. Hartz is recognized as one of the cleverest men in the business when it comes to getting cars ready for an Indianapolis race. He himself has won three second places and two fourth places in years past, but he is now

definitely out of the driver's seat.

A further note of interest is that the race was won for the first time in its history by a front-drive racing car, with a front-drive mechanism that is practically a duplicate of that in the most popnlar front-drive car in America. Another front-drive won sixth place, while still another won seventh.

The average of the race—100.448 miles an hour—was the highest of any 500-mile race except one: that won by Peter DePaolo in a Duesenberg Special in 1925, when the average was 101.13 miles an hour.

THE race brought back into racing the four-cylinder car, and evidently it will stay because of its good showing. Ten of the drivers went to the four-cylinder because these motors could be obtained with large piston displacement from a west coast maker who knew engines thoroughly. The fact that the limit of two carbureters might make carburetion difficult for multi-cylinder cars no doubt was another factor, as the drivers of the fours were certain of good carburetion with two carbureters to four cylinders.

Louie Meyer's carburetion on the sixteen-cylinder Sampson Special, however, with two downdraft carbureters, was very good; so good, in fact, that he had the greatest acceleration on the track and qualified his car at 111.290 miles an hour for four laps of the two and a half mile track, next to the fastest qualification made. The racing drivers handled their carburetion well on the eights.

In qualification, Arnold, the race winner, averaged 113.268 miles an hour. He took the lead after Louie Meyer and his Samspon Special had held it for two laps and after that was never headed. Arnold stopped in the 111th lap for right and left front tires, oil, and gas, taking three minutes. He made no more stops until the finish of the race, and had no mechanical trouble.

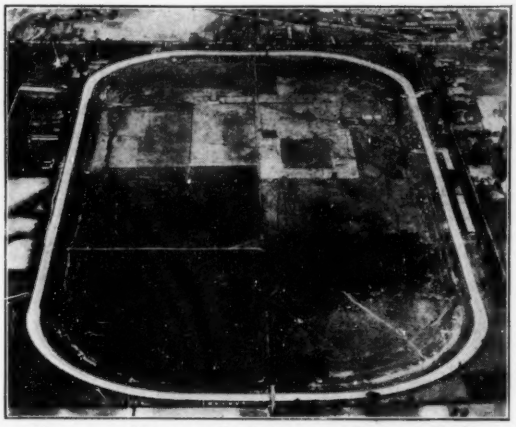
William Cantlon, second place winner, qualified his car at 109.810 and was the third highest qualifier. He stopped at the pits in lap 97 to take on a right front and right rear tire, water, gas, and oil, and gave up his wheel to Herman Schurch, relief driver. The time at the pits was 2 minutes 15 seconds. Schurch stopped in lap 151 for 25 seconds and Cantlon took the wheel.

Louis Schneider, in his Jones-Maley Special, had no mechanical trouble. He stopped at his pit in lap 102 for 1 minute 20 seconds for a right rear tire, gas, and oil. In lap 184 he stopped for 40 seconds for gas and to tighten up a shock absorber.

Arnold's car develops approximately 150 horsepower; while Cantlon's develops approximately the same. For those interested in gear ratios and engine compression, Cantlon's four-cylinder car pulled a 3.9 to 1 gear and its compression ratio was 10 to 1. This is the highest compression ratio used in the race, the average being between 6 and 7 to 1. The gear and compression ratio of the winning car could not be ascertained.

ARNOLD wound his engine up to a peak of about 6200 revolutions per minute. Cantlon's peak was about 5000, while Schneider, the third man wound his to between 5600 and 5800. Louie Meyer wound his sixteen-cylinder car to a top of 6100.

The Sampson Special of Louie Meyer is unique in construction. Its two banks of eight cylinders are placed vertically and each has its own crankshaft, cooling system, and oiling system, only the gasoline system being a common one. Even the radiator is separated in the center, there being no connection between the two sections. Each water cooling system holds approximately four gallons. Each of the two crankshafts has a gear on its front end and these two are connected at the front of the motor to a like gear on a shaft which runs between the two banks back to the transmission. The motor was reversed, to obviate the necessity for a change in the transmission and rear-drive assembly. It had a total displacement of 203 cubic inches and was the highest priced car in the race, representing an investment of approximately 16,500 dollars.



The round-cornered, brick track on which the races are run, as it appears from an airplane

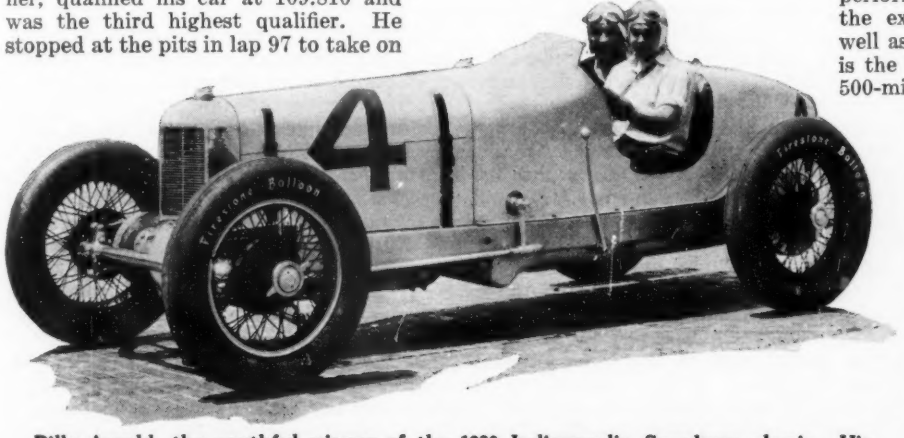
The outstanding performance in the race was that of a Jones-Stutz Special. This car was entered by Milton Jones, a private owner, of Cleveland, Ohio, and was driven to tenth place by L. L. Corum. It was stock in every particular except that its oil and gas tanks were made larger for the sake of fewer pit stops for fuel and oil, and the fenders and running boards were removed.

THIS car weighed 4600 pounds at the starting line. It ran the entire race without the hood being lifted except to add two quarts of oil. In spite of its great weight it made no tire changes, the four original ones going through in perfect shape and with so little wear that they evidently were good for thousands of miles more of ordinary usage. The tire wear and performance of the car is a tribute to the excellent balance of the car as well as its mechanical perfection. This is the best stock car performance the 500-mile race has ever seen, even in the days when modified stock car racing was the vogue.

It was unfortunate that the duPont Special, the only factory-entered car in the race, had a smash-up and was put out of the race. This car's performance would have been watched with interest because of its near-stock set-up.

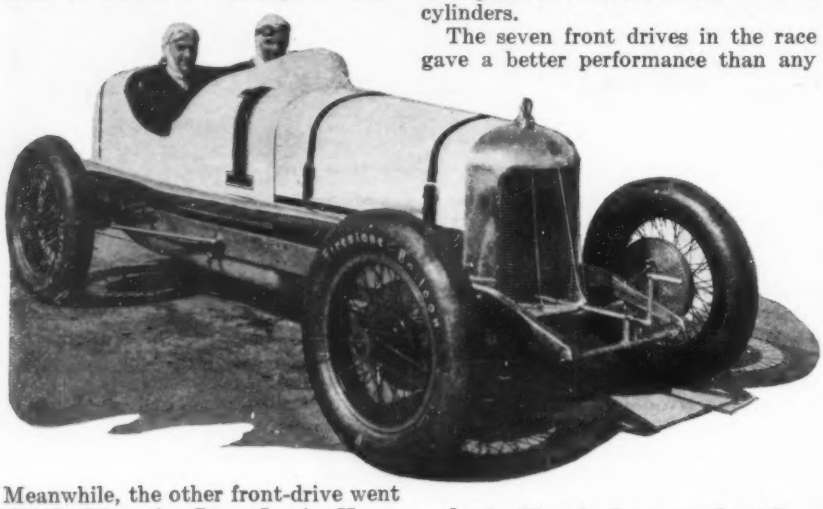
Bill Cummings' Duesenberg Special had a motor that formerly was in a Duesenberg stock car. A new head, not stock, was made for the race.

Dave Evans' Jones-Maley



Billy Arnold, the youthful winner of the 1930 Indianapolis Speedway classic. His Miller-Hartz two-man racing car is the first front-drive to have won this annual race

front-drive was, in part, the second front-drive of modern times, it being one of the two cars built by Harry Miller for the 1925 race at Indianapolis. It is a peculiar commentary that it sat in its garage throughout the race in 1925 because DePalma, Duray, Bennie Hill, and other big drivers of that time decided they did not wish to handle it through a race.



Meanwhile, the other front-drive went ahead, driven by Dave Lewis, Harry Miller's brother-in-law, and won second place in the race at 100.82 miles an hour—faster than first place in this year's race.

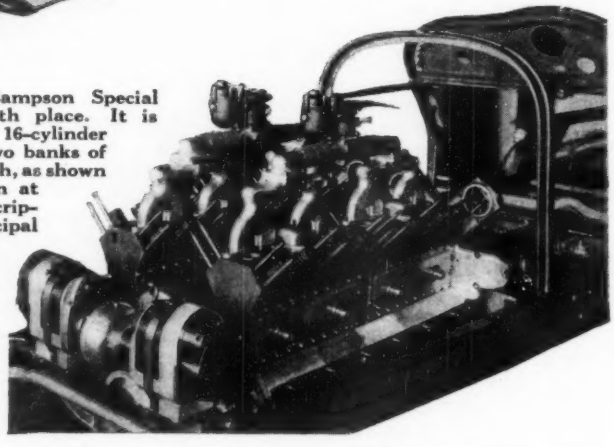
In winning seventh place with a Coleman front-drive, the entry of the Coleman Motors Corporation, of Littleton, Colorado, Phil Shafer demonstrated the correctness of the theory of the Coleman. Its front end embodied many of the features of the Coleman four-wheel-drive truck on a smaller scale. The Coleman broke all racing tradition and calculations by carrying most of its motor weight unsprung, the front motor support being on the front axle. The Coleman differs from other front drives in that it has only one front axle, the driving one, and not a subsidiary one to carry the weight as is the case with others.

SHAFER, in averaging 90.921 miles an hour with his car, which has a top speed of about 103 miles an hour, miscalculated the speed at which the race would be run and held resolutely within striking distance of 93 miles an hour, his estimate of the winner's average. The motor used in the Coleman was a 183 cubic-inch Miller four-cylinder. Another Coleman, driven by Lou Moore, was in a crash and did not finish the race.

The car to finish in eighth place has a stock Studebaker eight President motor; and many of its chassis parts, including the frame, are stock. Snowberger's performance was noteworthy. His top speed was approximately 104 miles an hour but a broken shock absorber stud caused him to decrease his speed and he lost his chance to win.

Leslie Allen's Allen-Miller Products car was strictly a racing car, with a four-cylinder Miller engine of 183 cubic inches. The remarkable part of Allen's average of 85.749 miles an hour was that he put a valve through one of his pistons, with more than 100 miles to go, yet he drove to the finish at a speed of 80 miles an hour on three cylinders.

The seven front drives in the race gave a better performance than any other group in Indianapolis race history, where they have been performing since the 1925 race. With the exception of the two Colemans, all of them were of the Miller-made type, basically identical in construction of their front-drive units and used eight-cylinder engines.



Louie Meyer's Sampson Special which took fourth place. It is powered with a 16-cylinder motor built in two banks of eight cylinders each, as shown in the illustration at the right. A description of its principal features is given in the text. In it, Meyer made an average speed for the race of 95.253 miles per hour, and had no trouble with his carburetion

The eleventh-place car was entered simply as a V-eight. It was in reality an Oakland V-eight engine, being the only V-eight in the race. It made a highly creditable showing for a motor that was all stock except its pistons, according to its entrant, Ira Vail. It had qualified at 97 miles an hour.

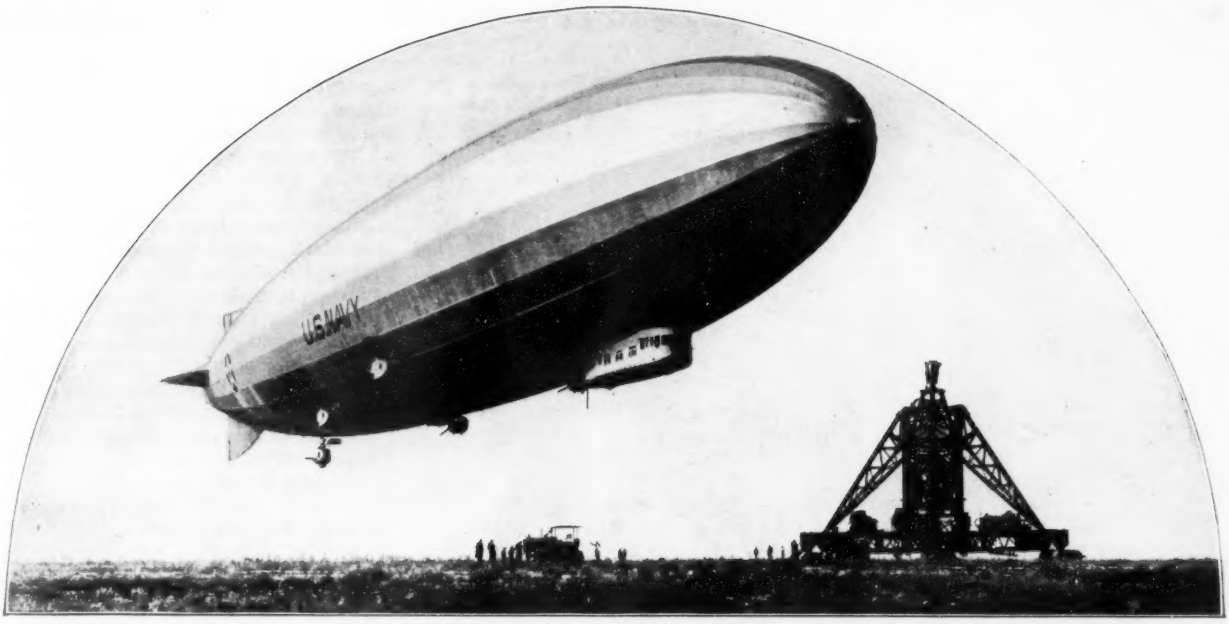
The twelfth car to finish, the Maserati eight, driven by Letterio Cucinatto, of Italy, was the only foreign car to finish, the other one, a sixteen-cylinder Maserati, stopping in the early part of the race with motor trouble.

The car running in thirteenth position was a Fronty Special. This little car, made up of Model T and Model A Ford parts, did especially well. Its transmission and clutch are Model A. The engine is Model T, with special Fronty head. The crankshaft, connecting rods, and pistons are non-stock. The chassis is Model T, including the transverse springs, front and rear. This car qualified by doing four laps of the track at 97 miles an hour. It was running the race at between 85 and 90 miles an hour, when the technical committee member in charge of the recording of car conditions, saw that the eye of the front spring was broken off when the car came in for gas. The driver explained that it had been that way for an hour and, beyond making the car difficult to handle on the turns, no serious difficulty could result. The technical man was obdurate, however, and insisted that something be done. Accordingly, Stanley Reed and Tom Mulligan, entrants of the car, ran into the infield at the track and turned the first Model T Ford they came to up on its side and took off the front spring. They put it on their car, after the Fronty had been delayed 41 minutes. After the car finished the race they hastily jerked the spring off, and put it back on the car from which it had been borrowed, Reed says, without the car owner being any the wiser.

THE fourteenth, and last, car to be running, was the Butcher Special, entered by two Butcher boys of Wilmington, Illinois, one of whom drove while the other acted as mechanic. This car was a big Buick motor mounted in a small Buick chassis, cut down to a wheelbase that would do for racing conditions. It ran throughout the race, but at a very low average.

There were 37 cars entered in the race, but only 14 were running at the close of the race.

There were numerous car failures due to such causes as cracked cylinder heads and broken wrist pins, gas tanks, connecting rods, valves, water jackets, and clutches. Several serious smash-ups occurred.



The *Los Angeles* makes ready to tie up at the new mast

Mooring Dirigibles Mechanically

New Stub Mast and Other Equipment at Lakehurst Facilitate Mooring and Housing

A FEW weeks ago there occurred at the United States Naval Air Station at Lakehurst an event which marked the passing of another milestone in the development of rigid airships. The *Los Angeles*, having been landed from flight, was secured to mechanical devices near the hangar and with about 60 men attending various stations on this equipment the ship proceeded under mechanical power to her berth in the hangar while over 200 other members of the ground crew stood by in unaccustomed leisure and watched this performance in which they have usually had to participate so forcefully with brain and brawn—largely the latter. The first demonstration of practically the full mechanical system for docking airships had been successfully conducted.

Every since the inception of American development of the rigid airship, it has been realized that the field of terminal facilities and other auxiliaries represented a weakness in airship operation. The success of airship operation, both military and commercial, depends very largely on the achievement and provision of adequate, efficient, and economical terminal facilities. From the very beginning airships had been handled in and out of sheds by groups of men placed at strong points of the ships to haul against direct winds and gusts, manpower, of course, having the virtue of being highly flexible. As the size of ships increased, ground crews grew to several hundred men.

Lakehurst, being rather unfavorably situated from a meteorological standpoint, has from the very beginning impressed our airship personnel with the fundamental necessity for improvements in airship mooring and handling.

SHORTLY after the World War, the British developed an airship mooring mast which materially added to airship progress in making it generally possible for airships to remain at the mast until favorable conditions permitted housing them without difficulty, should housing be desired. One British airship remained based on a mast for a period of about six months.

However, this "high" type of mooring mast is not a "cure-all" for every airship need. Large ground crews are needed at some time or another when housing or unhousing becomes necessary. Consequently some unit other than the high mast had to be developed.

The method of housing and unhousing airships at first was to employ only men in groups about the ship in a manner similar to the tugs around an ocean liner. Then there were added "docking rails" projecting along the sides of the hangar and extending out on to the field and over which there traveled trolleys, two on a side, attached to the ship by suitable lines. Additional groups of men steadied the ship against the wind as she had to be moved parallel to the hangar. Such was the extent of the "airship handling project" when taken up at Lakehurst.

The mooring and handling problems resolve themselves into three phases: (a) landing the airship from flight; (b) mooring the ship out or "anchoring" it to ride, ready for flight, as a surface vessel anchors or swings to a buoy; (c) housing or unhousing the airship just as a surface vessel docks or undocks. The problem was one of combining, if possible, these three functions in one set of equipment and making that equipment as efficient and simple as possible. Two phases of this problem have already been proved practical; the third is still in the process of development, but present indications give promise of early solution.

In landing from flight, an airship formerly proceeded over the landing point and was pulled to the ground by man-power using ropes dropped from

Anchored to the stub mast, the *Los Angeles* will safely outride winds of more than ordinary velocities. The cabin, it will be noted, is close to the ground

her bow. In landing to a mooring mast the process is that of being pulled down against her buoyancy by mooring wires dropped from her bow and connected to corresponding ground wires which are then hauled in by power-driven winches. One of these wires pulls the ship downward while two others, leading aft at an angle to the ship, steady her against yawing tendencies arising from gusty wind conditions. These same two wires also prevent the ship from over-riding the mast and thereby possibly fouling her hull against the mast. By means of these three wires the steel cone on the nose of the ship is maneuvered into a steel cup on top of the mast where it is firmly locked.

ALTHOUGH this original method of mooring to a mast has been successfully used a great many times, it does not fully overcome the irregularities of the wind. It has been demonstrated repeatedly that there exists the necessity for providing an additional force to overcome the tendency of vertical gusts to drive the ship downward. Such vertical tendency may, of course, be overcome to some extent by making the ship more buoyant, but there is a practical limit to this measure and, therefore, there exists the necessity for providing a corrective force outside the ship.

The solutions of these several problems worked out at Lakehurst center largely in the demonstrated success of a low or "stub" mooring mast some 60 feet in height as opposed to 171 feet and even 201 feet in modern examples of the "high" mast.

The principal unit employed in the new mechanical system at Lakehurst is a low mobile mast capable of movement over the ground. This mast not only acts as the principal unit of the handling equipment, but also serves as a mooring device to which the ship may be moored for indefinite periods. It incorporates a telescopic feature enabling its height to be adjusted to suit different airships.

To utilize the mast for "anchoring" purposes there is provided a mooring site or circle in the precise center of which the mobile mast can be placed. Surrounding the mast is a circular, standard-gage railroad track on which runs an especially devised car to which the after portion of the airship is secured. In this way the mooring airship is secured at two places, that is, with the bow in the mooring mast cup and the after portion of the ship attached firmly to the car which moves with great facility along the circular railroad track thus allowing the ship to answer fluctuations in the wind directions just as does a weather-vane.

At this low or stub mast, which is an American idea, the lower part of the airship is held within a few feet of the ground, thereby expediting repairs, transfer of loads and personnel, as well as keeping the ship close to the ground where winds are of lower velocity than at levels of the "high" masts. When riding to a high mast the free stern of the mooring airship is practically always going through vertical and horizontal oscillations due to irregularities in wind flow and to temperature changes which temporarily influence the ship's buoyancy. At the American stub mast, the ship, while free to answer horizontal fluctuations, cannot acquire any vertical motion whatsoever and, therefore, the crew of the ship are not continuously flying the ship as is the case when she is moored at a high mast. This stub mast idea has had very successful practical demonstrations at Lakehurst and it is felt that if further results continue to be uniformly successful this type of mooring equipment will not only be developed to a point of increased efficiency, but will at the same time reduce mooring and handling costs materially.

IF after landing from flight, it is desired to house the ship in the shed, the ground servicing connections at the mooring circle are disconnected from the mast and the after portion of the ship is freed from its car. The mooring mast then gets underway with the ship's nose remaining secured just as when moored. Under the stern of the airship, however, there is placed a pneumatic wheel device capable of castering in any direction as well as of furnishing smooth rolling contact with the ground while the mast, with the airship riding to it like a flag, travels from the mooring site to the vicinity of the shed in which the ship is to be docked. A specially devised "tail drag" attached by a line to the ship's stern, follows the ship over the field, but resists any tendency of the stern to lift vertically, by adding its weight to the ship as automatic ballast. Furthermore the mobile mast's own pump and tanks can furnish the ship water ballast if needed as it moves over the ground.

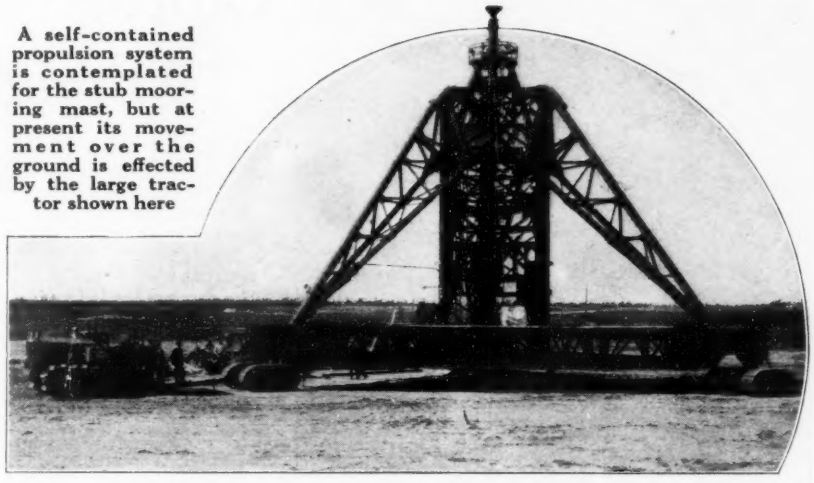
Having reached the docking rails which lie in the prolongation of the hangar direction, the mast comes to rest temporarily. The after part of the ship is secured on each side by an endless wire system which leads from four points on the ship to mechanical trolley systems which operate in the docking rails. These systems are provided with winches to haul the ship up against the wind load in case the wind direction is across the hangar, and enable the airship to be centered between the two docking rails. Held securely in this position, the mast, ship, and trolley systems get underway to-

gether and proceed into the shed. In undocking, of course, the reverse system is employed, the mechanical trolley bridle systems holding the ship against a cross wind until clear of the hangar where, by slacking off, the stern of the ship is allowed to swing until it finds its natural position of "nose into the wind." Signal lights similar to traffic lights, and a loud-speaker system mounted on the mast, provide the means for passing orders and information to units and personnel.

Having cleared the hangar, the ship can then either take to the air from that location or be towed to the mooring site or circle and remain there safely until its scheduled time of departure. The limitation on the wind force in which an airship can be docked and undocked by this mechanical means is dependent upon the strength of the airship itself.

IT would not pay nor is it necessary to build an airship structure strong and heavy enough to be capable of withstanding great forces in any direction or at random points. The *Los Angeles*, for example, was not constructed with any idea of mechanical handling devices being applied to it and still we find that the strength of the ship is adequate to allow it to be housed or unhoused in beam winds up to 20 miles per hour velocity. It would be, of course, expensive and complicated to change the structural characteristics of the *Los Angeles* to permit handling in higher winds. When, however, airships are originally constructed with a view to mechanical handling they can, of course, be made adequately strong for handling in greater wind velocities if desired.

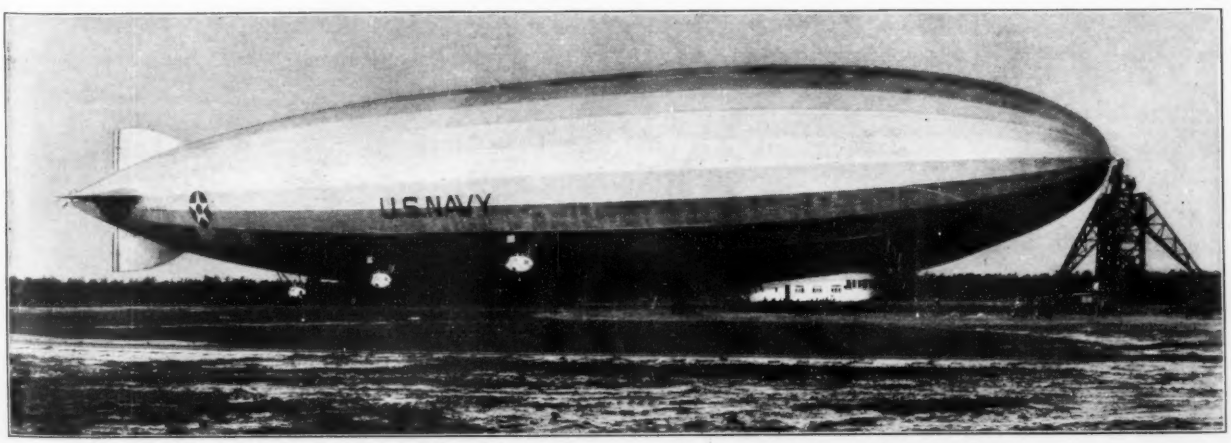
This mechanical handling system is not as yet a fully refined product. It will continue to be modified and perfected, perhaps for years, but fundamentally it has been proved correct. The "iron horse" of the mechanical handling system (as the mobile mast is often referred to) has already during its development period been used in handling the *Los Angeles* on over 30 occasions during the last few months, and by its use the *Los Angeles* has been housed and unhoused in cross-hangar winds of 17 to 20 miles per hour velocity; and it successfully handled the *Graf Zeppelin* while that ship was at Lakehurst last spring. At present its movement over the ground is by a tractor but a self-contained propulsion system for the mast is a contemplated refinement for the near future.



A self-contained propulsion system is contemplated for the stub mooring mast, but at present its movement over the ground is effected by the large tractor shown here

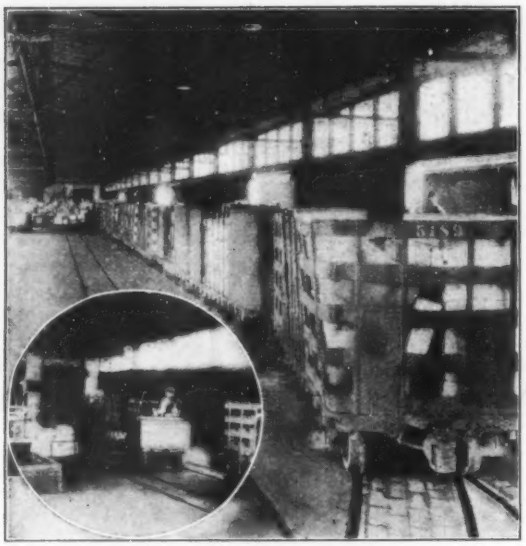
THE stub mooring mast, its mobile features, and other units of the mechanical handling system herein described have been devised, built, and operated by personnel of the United States Navy, principally through the efforts of the Bureau of Aeronautics, the Bureau of Yards and Docks, and the personnel at Lakehurst. No one else in the world has yet attained such solutions except the United States Navy which has been engaged in this arduous task for the past several years. Others, however, are now working on the problem. Recent press reports, for example, indicate that the British Air Ministry is now engaged in the provision of a mechanical handling system for airships, which, according to the announcements, appears to be almost identical with that developed at Lakehurst.

The mechanical handling system is but one of a number of most important airship projects and experiments being conducted by our Navy through the wise provision by Congress of funds for this most important pioneering work. By the continuation of sufficient funds for further experimental work, our Navy will undoubtedly soon contribute other very valuable features to airship operation and thereby expedite the attainment of the high value which the rigid airship potentially possesses not only for naval uses, but for commercial employment as well. With these developments, airship operation can be made practical and economical. We shall have added greatly to the naval usefulness of airships to our fleet. With our natural advantages, such as our helium resources and our great engineering resources, these recent developments should enable the establishment of an aerial merchant marine capable of carrying the American flag to the corners of the earth. In this as in many other pioneering fields, the way will have been pointed out by the Navy.



Swinging low enough for the convenience of passengers and for making repairs

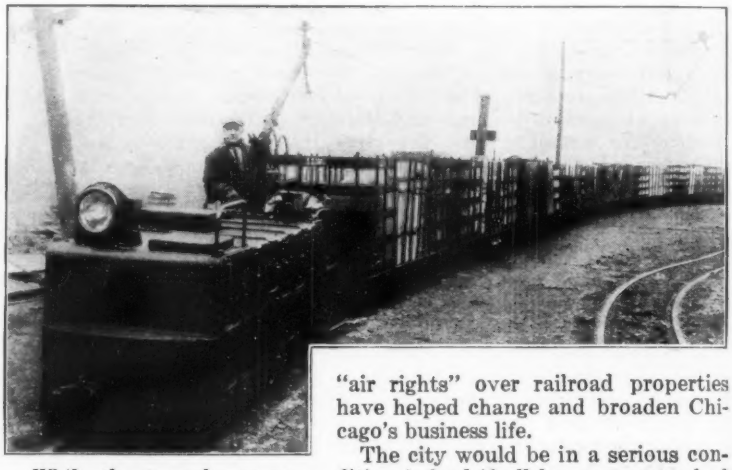
Chicago's Underground Freight System



The cars are loaded and unloaded in the warehouse and reach the tunnel level by means of electric elevators

WHEN Chicago was a bit younger, traction magnates conceived the idea of surrounding down-town Chicago with a belt-line elevated. The idea was probably a good one for the time, but it resulted in constricting and forcing upward hotel structures, department stores, and office buildings. This has resulted in great congestion, particularly in the streets, for until recently it was considered the thing to be in this "loop" and everybody's merchandise had to be brought in and sent out through this section. Now, however, the developments along the Chicago River and the utilization of "air rights" over railroad properties have helped change and broaden Chicago's business life.

One of the 734 tunnel intersections which make it possible to switch trains to any part of the underground system. The train dispatcher is never out of touch with the motorman



While the tunnel proper is 40 feet underground, much of the freight is picked up at the ground level either at the great railroad freight terminals or the company's own public stations used by 2000 shippers. Note the type of electric locomotive

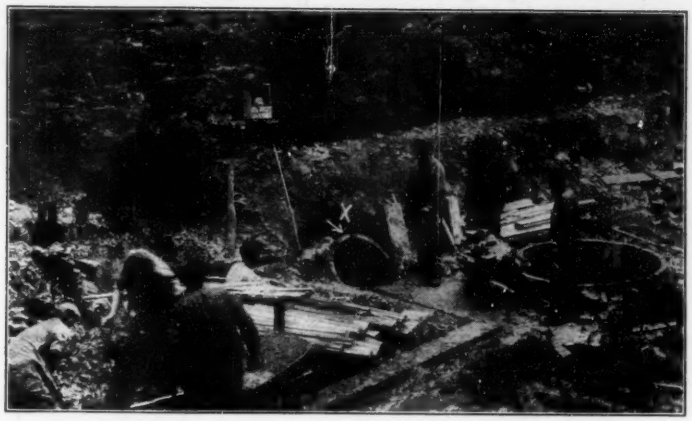
The city would be in a serious condition indeed if all her commerce had to be street-borne, but fortunately it is not, for 40 feet underground is an industrious mole which never sleeps: it carries freight, package merchandise, and coal, and removes ashes, rubbish, and earth from new buildings.

There are 62 miles of track in the tunnel. Seven hundred and thirty-four intersections make access easy to every street in the loop and as far

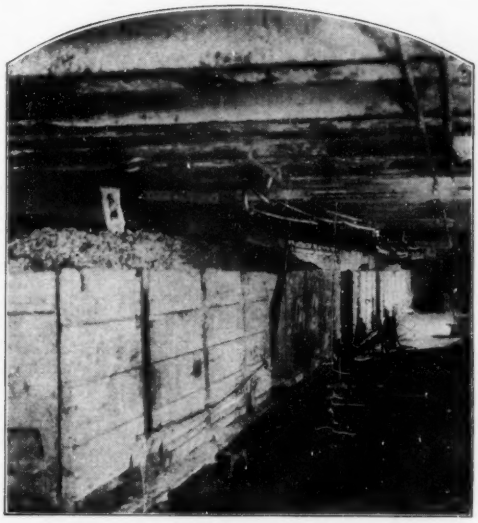
At the left is shown one of the coal chutes from which coal is dumped into the cars for transportation to all parts of the tunnel system. At the right will be seen the coal being dumped out on conveyor belts

distant as even the Field Museum. There are 3304 cars and 150 electric locomotives in use. The merchandise transported yearly amounts to 589,761 carloads, without counting coal, cinders, and excavated material.

Freight is received at public stations, or directly from the railroads or from connected buildings anywhere along the routes. Ninety-six elevators give access to the tunnel level, the cars themselves being raised and lowered on them. As an example, let us consider a world-famed department store. All its coal is delivered, the ashes removed, and much of the merchandise received and shipped without turning a wheel on the streets. What would New York give for a similar system? The movement of package freight between freight terminals is one of the most important functions of the system. The tunnels are also assisting the new World's Fair by taking quantities of excavated material to the lake front. Our illustrations give an excellent idea of the tunnel, its size (gage 24 inches, size of tunnel 6 feet by 7 feet 6 inches) and its uses. We are indebted to Mr. J. H. Burke, Traffic Manager, for a private view of it.

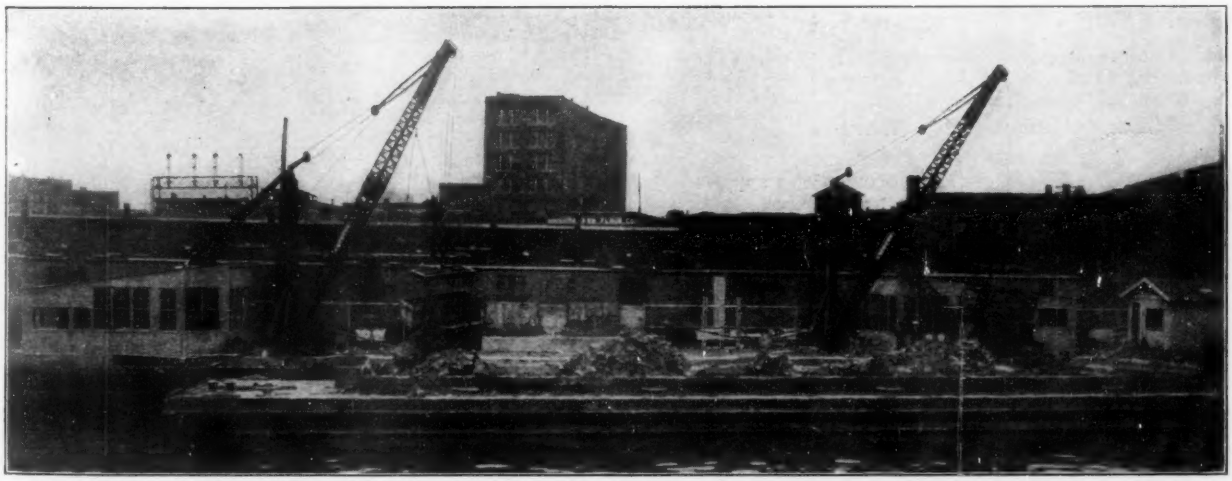


Excavation is easy in rockless Chicago if you are near the tunnels. You bore a hole and shoot the spoil through a chute to the waiting tunnel cars for ultimate disposal

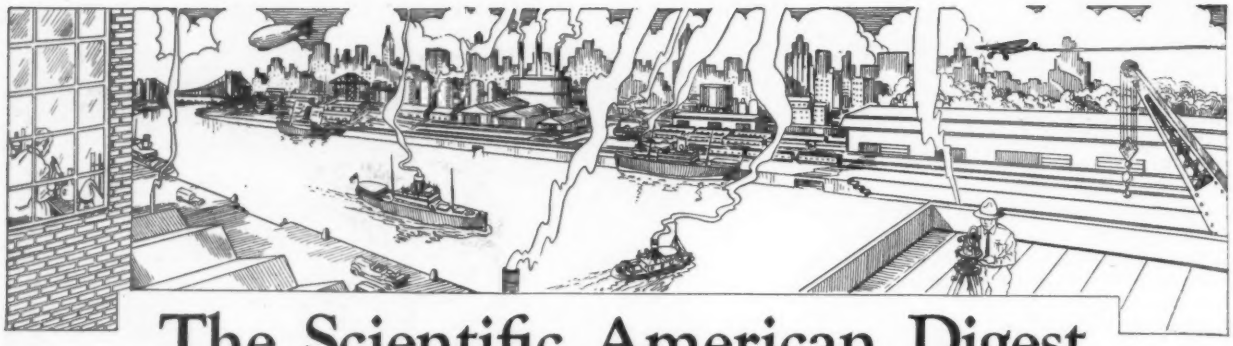


The tunnel takes away the ashes for disposal by dumping them into the lake

Shipping room of a large commercial house showing how freight is loaded on to tunnel cars



Here we have the refuse disposal station where excavated materials, cinders, and other wastes are loaded on barges which are towed far out in the lake for dumping. A total of 102,179 car loads were disposed of in a period of one year



The Scientific American Digest

Conducted by F. D. McHUGH

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Suspended Observation Car

THE Materiel Division of the Army Air Corps has employed a very simple, yet useful idea in connection with dirigibles. An observation car was suspended below an airship by a windlass and cable. By ordinary telephone, communication was successfully maintained with the pilot of the airship. Such a device would be invaluable in fog or in low ceiling work. The airship would hover aloft, while the observer reconnoitered, and then gave instructions for safe landing. Such a car was used by the Germans on their Zeppelin raids, and should be valuable in commercial operation.—*A. K.*

A valuable application of the photoelectric cell. It opens this restaurant door automatically

Door Opens Automatically When Approached

HARD-WORKING hotel waiters, struggling through kitchen doors with heavily laden trays and performing like circus acrobats to make the passage safely, need no longer suffer these agonizing evolutions, for the photoelectric cell has come to the rescue. The General Electric Company recently demonstrated an automatic door-opener by means of which, without conscious human effort, a door can be made to open swiftly and silently—and, what is more, to close in the same manner.

A ray of light focused on a photoelectric cell passes in front of the door. When this ray is interrupted it sets a hydraulic door-opener to work, through the agency of a photoelectric relay. The cell and light are placed several feet from the door and, as a person approaches, his body interrupts the light ray directed at the cell.

The current, hardly great enough to be dignified by the name, is amplified through three large vacuum tubes, the last a power tube. It then sets in motion a small motor which operates the hydraulic device, thus actually opening the door. A lever, comparable to those found on ordinary door checks, forces the door open. A suitable time then elapses before the door closes. When the ray of light is again focused on the tube, the device is again ready for operation. The length of time during which the door is held open can be changed by adjusting the control

Largest Gas Tank Known

SUPPOSE you had 200,000,000 cubic feet of natural gas that you couldn't use immediately? Where would you keep it? The novel answer to this "poser," evolved by the Canadian government experts, is as simple as it is ingenious. They could think of no container big enough to hold such a quantity of gas except the container from which it came originally, namely, the bowels of the earth. Accordingly, they have determined to pump the gas from a producing field back into the earth in a field previously exhausted. This plan has been approved by the Minister of the Interior, the Gas Conservation Committee, appointed jointly by the Federal and Provincial Governments, and the Premier of Alberta.

Among the conditions set out in the Order-in-Council under which the reservation has been granted, is the requirement that the company shall commence the actual injection of gas into the depleted sands not later than May 1, 1931, and the amount of gas to be so injected each year shall be not less than 200 million cubic feet until the maximum pressure has been reached and maintained.

The Bow Island gas field, in which the interesting gas storage experiment is to be made, is located about 140 miles southeast of the Turner Valley and a slightly greater distance from Calgary. Prior to becoming depleted it was the principal source of the natural gas supply for the city of Calgary. Now it is proposed to rejuvenate the old wells by bringing gas from Turner Valley, where great quantities are being wasted at the naphtha wells, and to store this gas so that it may be used whenever the peak loads on the company's gas lines may require such reserve supplies.—*A. E. B.*

Ragweed Pollen

THE vast majority of cases of hay-fever occur in people who are sensitive to ragweed. In the fall ragweed pollen is exceedingly prevalent in the air and hay-fever sufferers journey hither and thither attempting to avoid it. Dr. O. C. Durham made a survey of the entire United States during 1929 to locate the boundaries of the ragweed district. He says that the potential ragweed district is the portion of the United States east of the Rocky Mountains, except the south end of the Florida peninsula. In all parts of the area, from one to seven species of ragweed are found.

Thus the actual part of the United States affected seriously by ragweed is little less than three fourths of the total area of the country, but this three fourths contains nine tenths of the population. For each section of the ragweed distric

Experimental set-up of the photo-electric cell door opener. Light source is at right near knob and cell is directly opposite at left

the almost rigid dates of onset, climate, and termination of the season are being established, and it will soon be quite possible to tell the hay-fever sufferer exactly what day his symptoms are likely to commence in any definite region and almost the day on which they are likely to terminate. It will then be possible for him to move from the district or to take the necessary preventive measures exactly as they are needed.—*M. F.*

Elaborate Ancient Reservoirs

ADEN, on the Arabian peninsula, is a barren spot, for on the mountains and flat sections of this region there is not a spear of green growing things. Near the city of Aden, however, an elaborate series of 12 reservoirs collect what little rain falls and this is used for irrigation. The water quickly becomes foul and cannot be used for drinking purposes.

The reservoirs which empty into one another were partly excavated out of the solid rock many years ago. Of Persian origin, they were discovered in 1884 by a British officer and restored to the condition shown in the accompanying illustration.

The "storage battery" hydro-electric plant described in the accompanying text. During periods of low power demand, the pumps in this plant draw surplus power from the line and pump water uphill into the reservoir to furnish a head sufficient to run the generators during peak load periods

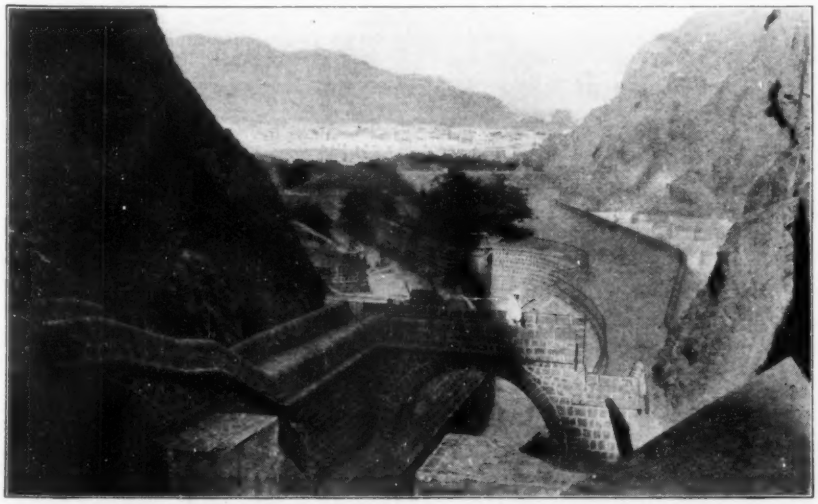
The Hearts of Athletes

FOR years it has been known that intensive athletic effort places a severe strain upon the heart which may result in chronic disability or even in immediate fatality. It is generally thought that the strain produces enlargement of the heart and cases have occurred in which acute dilatation has resulted. Recent investigations made by Dr. T. K. Richards indicate, however, that in the majority of instances after a hard race the heart is small.

When the athlete collapses he seems to be utterly exhausted, gasping for air, and unable to take a full breath. He complains of abdominal pain and lies on his side with his legs doubled up. Although he perspires freely, his body feels cold. In order to determine the condition of the heart, arrangements were made to look at the heart by means of the X ray before and after the race. Members of Harvard's varsity and freshman cross-country squads and individual distance runners of national fame were studied for the purpose. After a race, the hearts were constantly smaller than before the race. Moreover, the hearts of distance runners who had had many years of competition showed the greatest decrease in diameter after racing. As the man's condition improved, the excursions of the heart became greater and sometimes after an hour more the heart seemed to be dilated.

The indicating gas detector

The theory as to these changes that occur is that the contracted heart of athletes is the result of some form of muscle cramp due to excess of lactic acid in the muscle. The cramp can be relieved by inhaling carbon dioxide which sets free the lactic acid. It seems likely that the general collapse is due to the fact that the contracted heart is unable to supply the brain with sufficient blood and that the collapse is therefore due to some form of anemia of the brain.—*M. F.*



Beautifully built ancient masonry reservoirs near the city of Aden

A "Storage Battery" Hydro-Electric Plant

ON the Housatonic River near New Milford, Connecticut, the Rocky River hydro-electric plant of the Connecticut Light and Power Company pumps a river uphill in order to store up a sufficient head of water to run its own generators. It is the first plant in America to pump water for power generation. In general, the pumping is done when there is a surplus of power at other hydro-electric plants in the system. This water supply is used when there is a peak load on the system.

One 30,000-k.v.a. hydro-electric generating unit and two pumps, the latter driven by 8100-horsepower electric motors, have been installed. The head on the units varies from 200 to 230 feet, depending upon the level of the water in the reservoir.

Each of the two pumping units, which were designed and built by the Worthington Pump and Machinery Corporation, has a capacity of 112,500 gallons per minute, or 162,000,000 gallons per day. They are of the vertical-shaft, single-inlet, single-stage, bottom-suction, volute type.

On each pump, the driving motor is mounted directly on top of the casing. These motors are General Electric synchronous motors rated at 7900 k.v.a., 13,200 volts, and run at 327 revolutions per minute.

Indicating Gas Detector

IN various industries there has long been an urgent need for a gas detector which reads directly the amount of gas in an atmosphere being tested. Such a device has been developed in Austria and has been put on the market by the Bureau für Wärmewirtschaft, Laboratorium für Brennstoff-Untersuchungen, of Vienna.

This detector consists of a flexible metal membrane, resembling the case of an aneroid barometer, which is closed by a porous clay plate on one end. When the

device is brought into an atmosphere containing diffused gas, the gas penetrates the porous clay and fills the space between the clay and the metal membrane. The pressure therein is increased so that the membrane, which is connected to a pointer on an indicating dial, is distended. As the pointer moves, it indicates on the dial the approximate amount of gas in the air.

Navy Enlists Gas to Build War Ships

GAS has been enlisted by the United States Navy to play a large part in the construction of future vessels, according to reports from the Mare Island Navy Yard.

Although it was used in the past to cut up old battleships, gas played a larger part in building the recently launched U. S. S. *Chicago*.

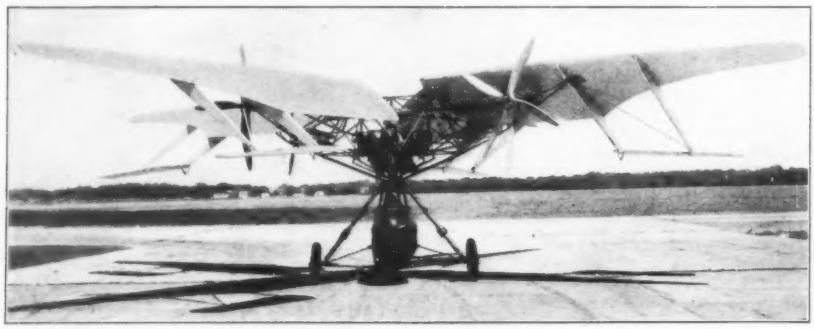
The 1,500,000 rivets required were all heated in specially designed gas ovens because the uniform heat produces stronger rivets and prevents oxidizing, according to the report. All the zinc used to galvanize the inner bottom of the cruiser for machinery foundations and for her fresh water tanks was melted in gas-fired vats. Gas was also used to bend all copper pipes installed and for much of the welding.

The Curtiss-Bleecker Helicopter

THERE is no doubt that the helicopter has possibilities of usefulness. It is unlikely ever to compete with the airplane on the score of speed or load carrying, but it might well act as an auxiliary to the airplane, bringing passengers, for example, from the heart of a city to the transport terminal. The helicopter also has military possibilities, such as for observation work in very rugged country where the airplane itself would be helpless. Such services by the helicopter have long been admitted as plausible, and great ingenuity and vast sums of money have been spent on the development of various types of direct ascent machines. Unfortunately, the history of the helicopter has been marked by a succession of failures. In many cases a reasonable conception has been ruined by insufficient fundamental research. Inventors have been too eager to build and fly their craft.

Now the Curtiss Aeroplane and Motor Corporation has entered the lists with a young engineer, Maitland B. Bleecker, as the inventor and designer of a helicopter. The Curtiss company cannot be reproached with too hasty construction. Systematic research was begun as early as 1927. This has covered aerodynamic work in the wind tunnel, investigations on the cooling of the engine, and so forth. At least we have here a brilliant young engineer, supported by a great company and with all technical aids at his command.

Brief descriptions of the helicopter have appeared in the daily and technical press.



First of the experimental helicopters to give some promise of successful vertical flight in taking off and landing, designed by a young aeronautical engineer

The writer has had an opportunity to examine the novel craft. The Curtiss company, however, has been chary of issuing adequate descriptions so far and the following remarks, although carefully considered, must be ragarded as reasonable conjecture for the most part.

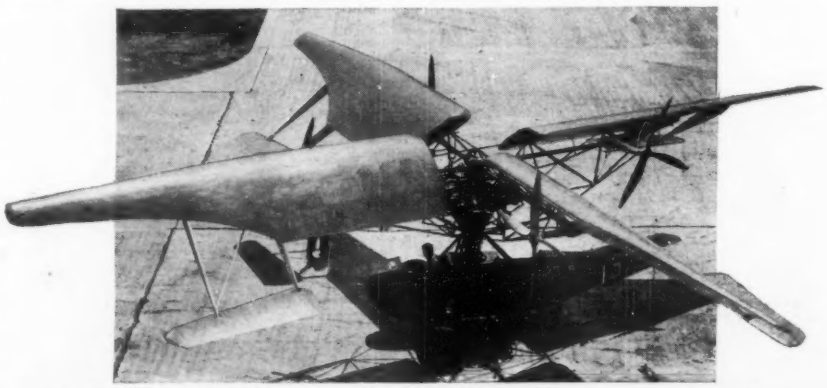
The Curtiss-Bleecker helicopter has but a single lifting system, comprising four rotating blades of airfoil section. With a single rotating system, if the engine were rigidly mounted to the fuselage or nacelle, then the fuselage as a whole would turn in space (action and reaction being equal and opposite) to the great discomfort of the pilot. This difficulty has been met by having the engine free to rotate in suitable bearings in the nacelle. The engine is mounted somewhat above the nacelle and behind the pilot.

The question of transmitting power from the engine to the main rotating blades is a difficult one. Nothing would appear simpler than to gear down from the engine to a vertical shaft, which would, in turn, rotate the blades. Unfortunately, a large speed reduction is necessary. The engine must revolve at high speed—2000 revolutions per minute or thereabouts—while the lifting elements should, for maximum lifting power, revolve slowly, say 150 revolutions per minute. The problem of gearing down and transmission without excessive weight, is a formidable one.

Again, the rotating blades must vary their incidence, or pitch, as they move along their circular path. The pitch must be varied rapidly for control or for descent with power off. The design of a good transmission system is complicated by these additional requirements. To avoid these difficulties, Mr. Bleecker has hit on a novel method of attack. He connects the engine through shafting to a number of small propellers, which, in turn, pull the lifting blades around, but leave the lifting elements more or less free from the transmission machinery. The central vertical shaft running from the horizontally placed Pratt and Whitney Wasp air-cooled engine is geared to four horizontal shafts, which again are geared to four, four-bladed propellers of relatively small diameter. The transmission system is external to the main lifting elements which are rotated by the thrust of the small propellers.

Another difficulty in the single-lift-screw-system helicopter is that, in forward motion, the blade advancing into the wind is meeting the air at a greater speed than the blade moving away from the wind. Therefore if the pitch on both sides is the same, the blade advancing into the wind will have a greater lift than the blade retreating from the wind. The result is a powerful rolling moment tending to bank the machine about its main or longitudinal axis. Such a rolling moment would be difficult to resist by the controlling means placed at the pilot's disposal, and even if met by the pilot would leave him dangerously little lateral control.

To meet this situation it is necessary to vary the pitch or angle of incidence of the blades automatically, as they whirl round. Herein lies the function of the auxiliary vanes or "stabovators" as they are termed by the Curtiss company, disposed at some distance behind the main blades. The area of the wings is 322 square feet and the stabovators have an area of 12½ square feet each. The main blades are presumably hinged at such a point along their chord that they tend, under a gravity moment, to increase their angle of incidence. When the stabovater is moving rapidly into the wind, its aerodynamic moment becomes greater in proportion to the gravitational moment. Therefore the stabovator tries to bring the wing down to a smaller incidence or pitch. If the whole delicate situation is correctly adjusted, then the decrease in pitch of the advancing blade balances the effect of the greater speed, and the lift on each side of the airplane is equalized. The dangerous rolling moment disappears. We believe this explanation to be an entirely plausible one; but later disclosures may modify it.



The Curtiss-Bleecker helicopter has a single lifting system comprising four rotating blades of airfoil section. The fuselage is not rigidly attached to the engine; the latter is free to rotate in suitable bearings in the nacelle

The designer of the helicopter has also worked out a system of control about all three axes. The directional control, or rudder, is mounted at the rear of the short nacelle. Contrary to practice with the conventional rudder, the helicopter rudder is hinged about a longitudinal axis. This is evidently so as to provide steering when the helicopter is either climbing vertically or soaring. Under such conditions, the rudder is in the downward slipstream of the main blades. If it were hinged about a vertical axis, nothing would happen. With the rudder hinged about a horizontal axis at its top edge the craft will turn to the right when the lower edge of the rudder is swung right. Our readers will no doubt agree with this supposition after a little reflection. For lateral control and longitudinal control, an ordinary "joy stick" is placed in the nacelle. The joy stick is so connected with the rotating blades that the pitch can be changed either on the right or left side, or ahead or behind the pilot. We imagine that a system somewhat analogous to the floating aileron is employed. Thus a complete control system is provided for.

All the main blades can also have their pitch changed simultaneously. This means that they can be given a negative pitch when the engine fails. The blades will then continue to rotate as a wind-mill, providing lift for either vertical descent or descent on a steep path. Ability to change the pitch is also important from the point of view of maximum climb and forward speed. In vertical climb the pitch should probably be somewhat greater than in forward flight. To secure forward flight, the elevator system is employed to tilt the machine slightly down by the nose, so that a part of the lift now acts to give forward pull.

A great deal of thought has gone into the power plant system. Gasoline and oil tanks are mounted so that they rotate with the engine. Electrical connections are taken off the rotating system through the use of a commutator. Through an ingenious system of gearing the pilot has normal throttle control available. A tripper device allows the gasoline feed system to be shut off while the rotor is in motion. To cool the engine, since it is *not* in the slipstream of the conventional propeller, a 32-inch diameter propeller-type fan is placed above the engine, with special baffles to guide the air all around the engine.

The landing gear is more or less conventional but the travel of the oleo struts is exceptionally large, to allow for vertical descent with power off. The tail wheel is of the caster type.

The gross weight of the helicopter is 3400 pounds. The useful load is small and some 20 percent of the gross of this useful load—180 pounds—is in fuel.

The main criticism of the helicopter is complication and the fact that there are so many transformations of energy to be reckoned with. The engine drives shafting. The shafting drives the small propellers. The propellers pull the main blades round. The main blades tilted forward provide the forward pull for the entire craft. Each of these transformations spells a loss. There is no doubt, however, that the Curtiss company will proceed with the utmost caution and will persevere, meeting difficulties as they occur and improving the machine step by step. We wish them every success.—*A. K.*

Cock-pit of the helicopter, showing connection of engine and body

Exports of Farm Machinery

EXPORTS of agricultural machinery and implements in 1929 amounted to 140,800,000 dollars compared with 116,000,000 dollars in 1928. This increase of 21 percent over the high record established in 1928 is of importance to business, as it relates to one of the great industries that is a large employer of labor and an extensive consumer of raw materials. Barring unforeseen calamities to the crops, the outlook seems to be for a continued increase in these products both at home and abroad.

The manufacture of farm machinery and implements in 1928 accounted for 2,200,000 tons of steel, or 6.5 per cent of the total consumption of steel in domestic industry. As the railroads used 16 percent of the country's steel, the farm-machinery business called for 40 percent as much as the railways. This business also called for almost exactly the same tonnage of steel as was exported. Sales of this type of machinery in 1929 were larger than in 1928, due in part to the increase in exports. Thus the export field demonstrates its importance in maintaining one of our great manufacturing industries.

The great increase in power-farming machinery shipped out of the country shows that the trend towards the mechanization of agriculture is not an exclusively American feature. Canada and Argentina, great export wheat-growing countries, and Russia, a "hope to-be" exporter, are the leaders in this kind of machinery. Tractors are one of the features of these exports to the wheat-growing countries. Doubtless our new plan of "farm relief" by reducing acreage and raising less will receive the enthusiastic endorsement of these three countries that stand to profit by taking whatever trade we shut ourselves off from supplying.

Of those countries, Canada, Argentina, and Russia offer great possibilities for power farming. Canada's prairies are especially adapted for it, and the great increase in such heavy machinery taken in the past year shows that the farmers there are appreciating the value of mechanized agriculture. All such methods of production as this decrease the cost and make it possible to sell wheat at lower prices in the world markets. When crops are fairly good, therefore, it stands to reason that this line of manufacture will prosper both at home and abroad.—*Barron's.*

Refrigerating Fresh Fruits

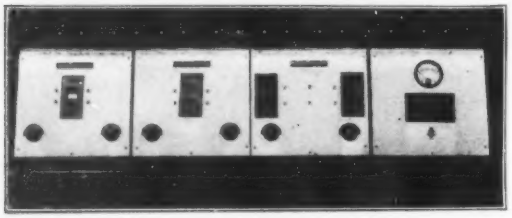
FRESH Georgia peaches at Christmas-time are the latest triumph in food preservation by freezing. Advances in refrigeration practice accompanying the freezing, distribution, and display of frozen food-stuffs were featured at a recent meeting of the American Society of Refrigerating Engineers, held in Atlanta.

Poised ready for flight with a pilot and one passenger

Plans for the production of frozen Georgia peaches on an extensive scale were described by W. R. Tucker. Sliced peaches packed with sugar are to be quick-frozen in one-pound waxed paper containers and then held to supply the "out-of-season" high quality demand.

Extensive experiments covering more than two years preceded the plans for large-scale production. Unsatisfactory for canning because of the very delicacy of cellular structure that is their chief asset from a flavor standpoint, Georgia peaches have presented a difficult over-production problem. Flooding of the market during the brief season in which they reach maturity could be avoided, Mr. Tucker said, by withholding in a frozen condition a sufficiently large part of the crop.

As a result of experiments made last year, the most satisfactory varieties, the proper freezing time, freezing and holding temperatures, and container size have been determined definitely. More than 10,000 pounds of peaches were frozen by Mr. Tucker and his associates at the height of the producing season last year, and stored until Christmas time. Then they were packed in solidified carbon dioxide and sent to leading hotels, representative peach growers, home economics bureaus, and other interested individuals. An amazing unanimity of opinion to the effect that these peaches were indistinguishable from freshly picked products resulted from this test. With the plans that have been developed, large-scale production will make it possible to market frozen peaches at a price that is considered reasonable for such high-quality products. It is planned eventually to effect national distribution throughout the period when fresh fruit is not available, Mr. Tucker said.—*A. E. B.*



Panel of the four-unit Model C short wave receiver. Either two, three, or four units may be used as a complete receiver

The Trend to Short Waves

THE growing use of low waves for broadcasting is creating a demand for low-wave receivers, which is being met by several manufacturers, one being C. R. Leutz, Inc., makers of the short-wave Model C receiver illustrated in these columns.

The Model C is of unit construction, allowing maximum flexibility; either two, three, or four units may be used together as a complete receiver. The simplest combination is the detector stage and audio unit combined, to which the first and second RF stages can be added. Since each unit is in a separate aluminum cabinet, double shielding is effected, each radio frequency stage, the detector stage, and the three audio stages being in separate compartments. The resultant isolation between the tuned stages is an important factor in the performance of the set.

The tuned circuits in this receiver are designed for maximum and uniform efficiency over the entire frequency range. Ordinary short-wave adapters obtain a wide range by the use of small coils and a large tuning condenser. Vacuum tubes, being voltage operated, require maximum inductance and low capacity, to meet which demands a higher manufacturing cost than is the case with the first-mentioned method of obtaining width of range. But in the Model C short-wave receiver, efficiency displaces cost as the determining factor. Of course, the receiver is unsuited for ordinary broadcast wavelengths, but its efficiency on the short waves is very high. The condensers are of fine construction and of the low loss type; the various tuned circuits are completely shielded; and there has been provided an elaborate system of chokes and by-pass condensers, which confine the radio frequency currents to their proper paths.

One of the problems of short-wave receivers using few tubes is to secure sufficient amplification in the detector circuit to operate properly the powerful audio amplifier. To meet the requirements, the Model C receiver has two tuned radio frequency stages. The push-pull audio amplifier has been purposely omitted since the extra input signal required to secure full output cannot always be conveniently obtained in a short-wave circuit. A receiver employing push-pull would operate well enough on strong signals, but the weak ones would be entirely lost. The sensitive cascade amplifier guarantees loud speaker volume.

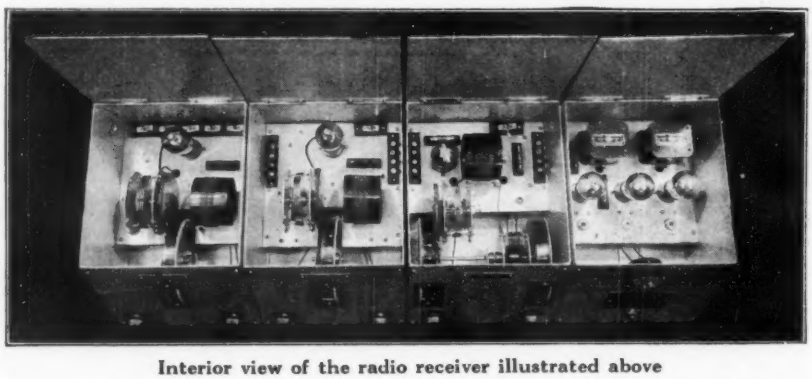
The Model C short-wave receiver is sold without coils, which may be purchased separately to cover any desired bands or wavelength ranges.

Mineral Oil and Cancer

BECAUSE of the publicity given in recent years to the possibility of producing cancer in human beings by contact with lubricating oils, Dr. Francis Carter Wood of the Columbia University Institute of Cancer Research undertook a study to determine definitely whether or not the ordinary mineral oil used for laxative purposes might have any effect in stimulating the growth of cancer. It is well known that "mule spinners" in the cotton industry, whose clothes are saturated with lubricating oils from the machinery which they use, develop cancers at spots where the skin is irritated by the clothing saturated with oil.

It has also been well established that cancer may be produced in mice by rubbing them with tar. It was found that painting the skin of mice with heavy lubricating oil would produce irritation and overgrowth, but painting the skin of mice of the same type with mineral oil of the kind used for laxative purposes did not produce anything resembling cancer. Feeding of mice with mineral oil did not produce any changes in the intestines or stomach, neither did the feeding of rats with such oil have any cancer-producing effect. It is well known that the skin of the albino mouse is just as sensitive to irritation by oil as is the human skin, and that both albino mice and rats may develop spontaneous cancer of the intestines.

Hence there is no reason to believe that mineral oils, as used in modern life for the treatment of disease, have any cancer producing effect.—*M. F.*



Interior view of the radio receiver illustrated above

Air Trespass Over Private Property

WE pointed out in an editorial in our May issue that the old theory that a property owner's rights extend to the skies has no basis in fact. A federal court, sitting in Cleveland recently, apparently concurred with us in this opinion, but the decision of the court did give to the property owner "possession" of the air up to a height of 500 feet above the land he owns. This is an interesting commentary on the growing need for study of the many legal problems confronting aviation today and, so far as we can learn, is the first really definite legal opinion that a plane may be actually liable for trespass even though it does not touch the ground over which it illegally flies.

Salvaging Everything but the Rattle of Derelict Cars

FOLLOWING the systematic wrecking of more than 18,000 antiquated motor cars, the Ford Motor Company recently announced that the salvaging of materials obtained in this manner is practical and that it is now increasing its facilities for continuing the work on a more extensive scale.

At the present time a force of 120 men at the Rouge plant, Dearborn, dismantles these apparently worthless hulks at the rate of 375 cars every 16 hours. Many parts, such as tires, are salvaged in their

entirety and other materials are being converted into useful articles, while the steel is remelted in furnaces to do its bit in the manufacture of Ford cars and Ford trucks.

The derelicts are bought from dealers at a fixed price of 20 dollars a car. There is no restriction as to make, age or condition, except that all cars must have at least some semblance of tires and a battery.

The salvaging of cars that have outlived their usefulness serves three ends. It will rid highways of motor menaces that are dangerous both to life and traffic; it will, to a large extent, free the landscape from unsightly junk piles; and it will convert into usefulness material that would otherwise go to waste.

The present method is, first, to drain the cars of gasoline and oil, both of which are salvaged. Grease is also saved. The cars are then hauled into the building and placed on a progressive conveyor. The headlight lenses and lamp bulbs are recovered. The spark plugs and battery are taken out. All glass is removed. That which is whole or may be cut to useful sizes is utilized for glazing in Ford plant buildings. The broken bits are sent to the Rouge glass factory for remelting. Floor boards travel to the box factory to be used for crate tops.

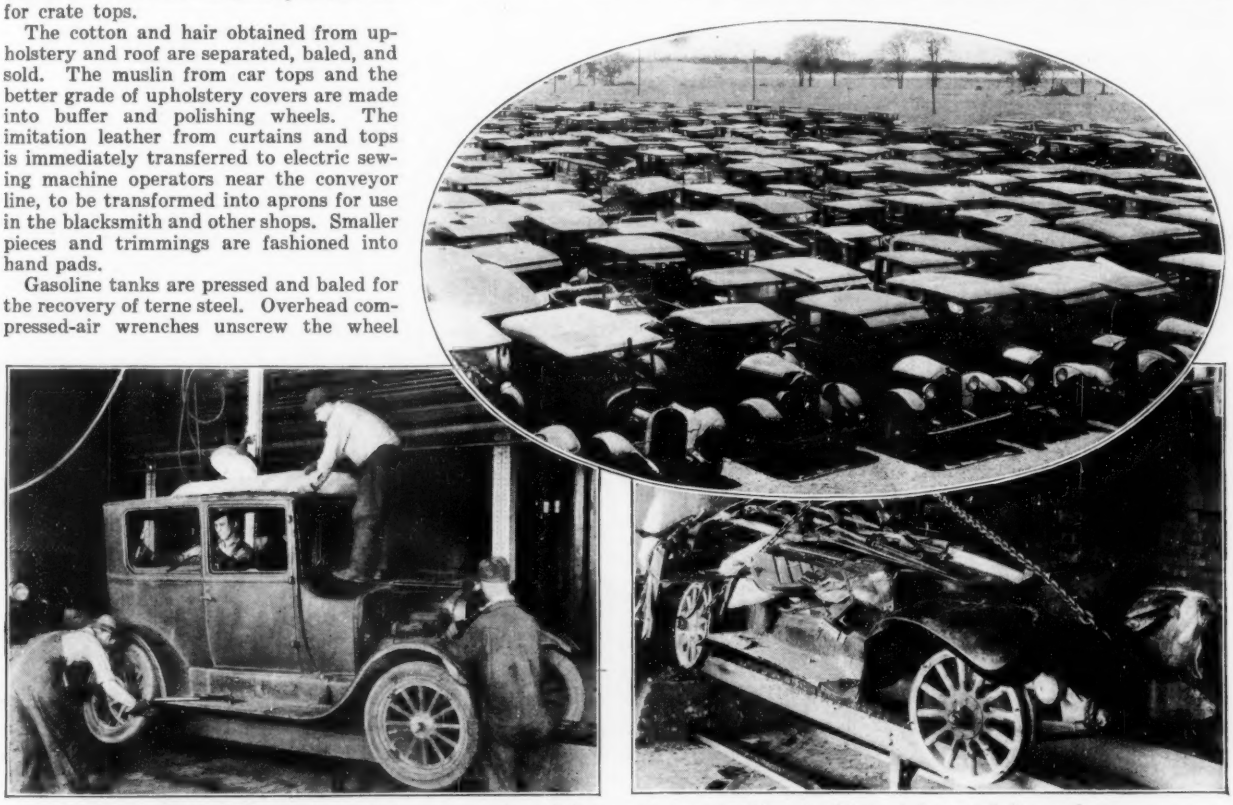
The cotton and hair obtained from upholstery and roof are separated, baled, and sold. The muslin from car tops and the better grade of upholstery covers are made into buffer and polishing wheels. The imitation leather from curtains and tops is immediately transferred to electric sewing machine operators near the conveyor line, to be transformed into aprons for use in the blacksmith and other shops. Smaller pieces and trimmings are fashioned into hand pads.

Gasoline tanks are pressed and baled for the recovery of terne steel. Overhead compressed-air wrenches unscrew the wheel nuts. When the wheels are removed the tires are inspected. If the tread is good they are sold as used tires at the commissary; otherwise the entire unit is placed in automatic shears which sever both tire and rim. The tire is quickly stripped and tossed into a waiting cart to be sold as old rubber. The rims join others for use as furnace scrap.

Horns are salvaged. Likewise hubcaps for aluminum, ignition wire for copper, oil cups for brass, bushings for bronze, and other bearings for babbit. All metals are kept separated by depositing each kind in steel barrels.

As the conveyor-propelled, and now all but dismantled, cars reach a station near the end of the salvage line, men with oxygen torches burn the motors loose from the frames. Overhead compressed-air hoists are attached to the motors and they are swung to a washer. This bath of boiling water and soda ash expels them from the opposite end free from grease and dirt. Meanwhile what is left of the cars continues on the conveyor into a 22-ton press which crushes them. The remains are then transferred to the third conveyor which carries them to the furnace doors.

All Model T engines are conveyed past the washing machine to a group of specially designed presses where they pass through a special process of disassembly.



In the three views above, the oval shows a section of the receiving yard at the Ford plant where old cars are stored awaiting junking; below at left, workmen are stripping the car; at right, car pressed after stripping

553 Hours in the Air

IN the refueling endurance record flight of John and Kenneth Hunter, which ended late in the afternoon of July 4, the engine was put through the most grueling test to which an airplane engine has ever been subjected. The Hunter brothers remained in the air for 553 hours, 41½ minutes.

The engine used was a Wright Whirlwind 300, which, before the beginning of the flight, had already had 300 hours service. During the endurance flight, the plane flew approximately 40,000 miles, non-stop, around and around in the vicinity of the airport. This figure, however, is small in comparison to some of the performance statistics of the flight. The revolutions made by the crankshaft were 52,000,000; each valve opened and closed 26,000,000 times; strokes made by each piston were 104,000,000; each piston traveled 9025 miles; and the revolutions made by the supercharger amounted to 405,600,000!

Brain Changes After Gas Poisoning

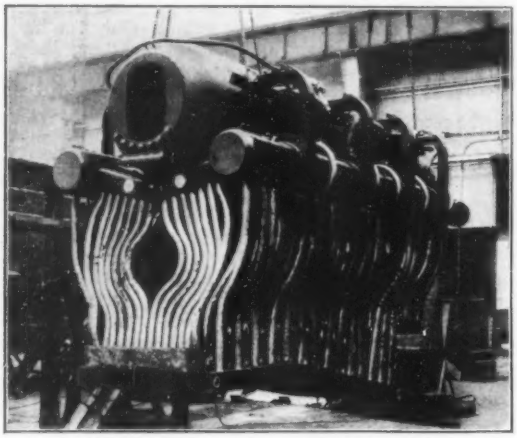
POISONING by illuminating gas containing carbon monoxide is one of the most common conditions in modern life. So wide are the uses of gases that the hazard is almost constant. Only the high development of modern plumbing keeps the gases within reasonable limits. Moreover, there is also a hazard from carbon monoxide due to the amount of the gas contained in the exhausts from automobiles. Many cases occur every year due to running the car in a closed garage.

The immediate symptoms after gas poisoning are unconsciousness; if a sufficient amount of the gas has combined with the red coloring matter of the blood death promptly ensues. If the patient recovers, nausea, vomiting, headache, and weakness are not infrequently seen. After the patient recovers, even from severe cases, he may develop secondary conditions, including pneumonia, gangrene, and particularly changes in the nervous system. The nervous system of the human being is such a delicate structure and so highly developed that it is particularly sensitive to poisonous influences.

In a case described by R. P. MacKay, a locomotive fireman 29 years of age who was found unconscious in his garage due to inhaling exhaust gas from his car, developed serious disturbances of the nervous system and symptoms like those of shaking palsy, his speech became monotonous, and his hands and head were subject to tremor.

Mental decline and exhaustion followed as well as symptoms affecting the body generally and the skin. After many months the patient began gradually to improve, but apparently the recovery was not complete.

Thus the danger of such poisoning is not only the immediate danger to life, but the danger of producing such serious changes that invalidism remains permanently. Apparently the deprivation of oxygen causes changes in the nervous system which the body does not readily overcome.—*M. F.*



Boiler of the locomotive recently built in England for experimental operation at a high pressure of over 900 pounds per square inch. The manner in which high-pressure steam is generated in the vertical tubes and the steam drum above them is fully explained in these columns

Beard 1200 Years Old in Ancient German Grave

A 1200-year-old beard is the unusual find made in an ancient grave accidentally uncovered by ditch-diggers near the town of Lörrach in Baden, Germany. The workers came upon several burials, one of which was protected in a coffin made of rough sandstone slabs. This latter, when opened by Dr. Georg Kraft, of the University of Freiburg in Breisgau, disclosed the somewhat decomposed skeleton of a man about 40 years old, with a matted triangle of wavy, red-brown hair where the chin had once been. The beard has a curious shape, being pointed but longer on one side than on the other.—*Science Service.*

Experimental High-Pressure Locomotive

DURING the latter part of December, 1929, a new high-pressure locomotive was introduced on the London, Midland and Scottish Railway. It was built by the North British Locomotive Company, Ltd., Glasgow, in conjunction with The Superheater Company, Ltd., under the supervision of Sir Henry Fowler, K.B.E., Chief Mechanical Engineer of the London, Midland and Scottish Railway.

The frames are standard with those of the three-cylinder simple 4-6-0 type locomotives of the "Royal Scot" class. But the higher initial working pressure and the increased range of steam expansion possible with this new engine led to the adoption of the three-cylinder compound arrangement.

The high-pressure cylinder is located well forward between the frames, and drives the front pair of driving wheels by means of a cranked axle. The two low-pressure cylinders are located outside of the frames and are connected to the intermediate driving wheels. Both the high- and low-pressure cylinders are set at an inclination of 1 in 50 with the horizontal.

The boiler of this locomotive is the most noteworthy feature, the design for which The Superheater Company, Ltd., is primarily responsible. The boiler consists of three portions generating steam at 1400 to 1800 pounds, 900 pounds, and 250 pounds per square inch, respectively.

The 1400- to 1800-pound section forms the watertube firebox and is a closed circuit. The vertical tubes are connected at their lower end to the foundation ring and to the ring forming the base of the combustion chamber. At the upper end they are expanded into two cylindrical equalizing drums from which coils pass to the interior of the large steam drum. The steam circulating in these coils evaporates the water in the large steam drum and generates steam at a pressure of 900 pounds per square inch. This large drum is a machined forging of nickel steel. The steam generated in this drum is passed through the superheater to the high-pressure cylinder.

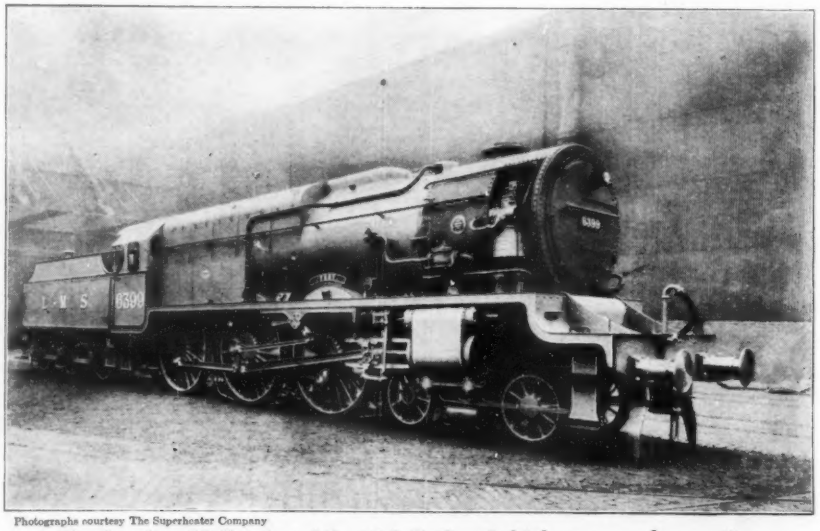
The forward portion of the boiler is similar to the standard locomotive boiler, the shell is of nickel steel and the tube sheets of mild steel. Steam is generated here at 250 pounds per square inch.

Water is fed to the high-pressure drum by a pump drawing its supply from the low-pressure boiler. Water is supplied to the low-pressure boiler by a live steam injector on one side and an exhaust steam injector on the other. Arrangements have been made to by-pass any excess pressure from the high-pressure drum to the low-pressure boiler to avoid waste through blowing off.

The throttle lever operates the high and low-pressure throttles simultaneously.

Steam from the high-pressure drum after being superheated passes to the high-pressure cylinder and is exhausted into a mixing chamber where it meets the low-pressure steam which has been superheated. The mixture of the two passes to the two outside low-pressure cylinders.

This locomotive weighs 174,200 pounds or, with tender, 261,600 pounds; and has a tractive effort of 33,200 pounds. It has been introduced experimentally to be used on the heaviest main-line express trains on the London, Midland and Scottish Railway.



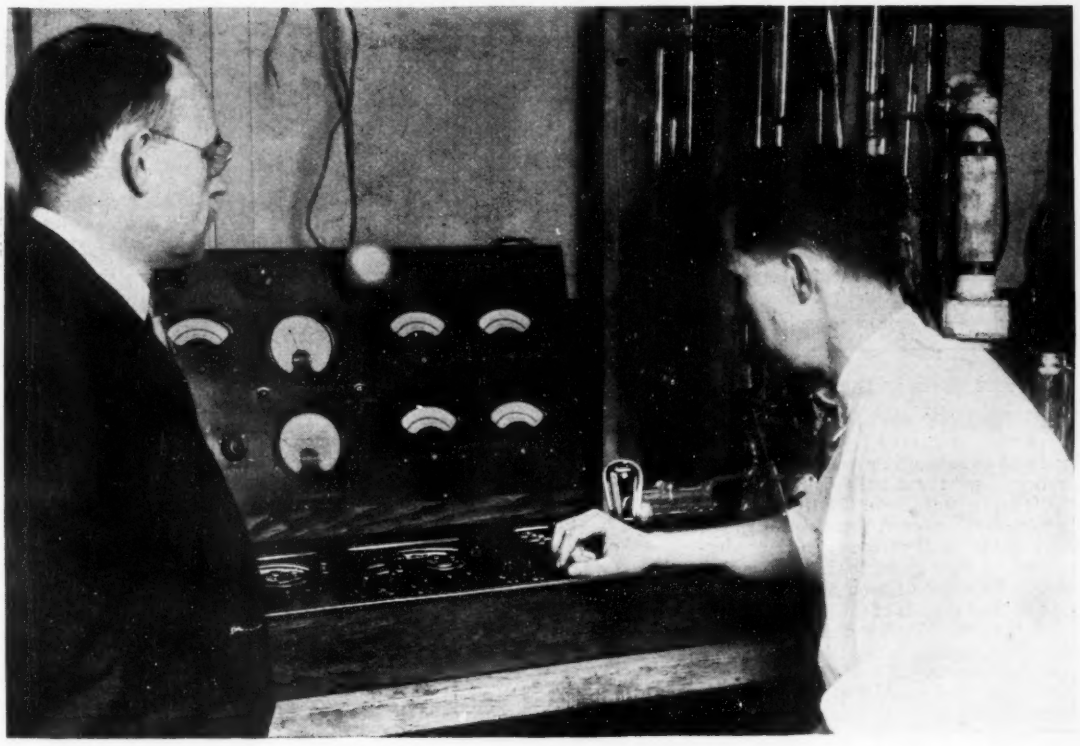
Photographs courtesy The Superheater Company

The London, Midland, and Scottish Railway's high-pressure locomotive

Chemical "Rain-Maker" Helps Modern Highways

IN this enlightened age, the professional rain-maker finds few customers gullible enough to believe that cabalistic incantations can precipitate a shower; yet chemical engineering has developed a thoroughly practical method of enticing moisture from the atmosphere. True, the method is not adequate for the farmer's horticultural needs, but it is extremely efficient for settling dust on dirt and gravel roads, and thus a boon to motorists and residents along the highway.

Calcium chloride is the substance which coaxes moisture from the air, even on the brightest days of summer. This snowy white chemical has the property that chemists call "deliquescence," which simply means that it has a strong chemical affinity for water and will attract it from the surrounding air, even when the latter is comparatively "dry." This property has long been known but it is only recently that chemical engineering has made calcium chloride available in the inexpensive, convenient form suitable for spreading on dusty roads. It is said that two applications during the dry summer months will settle the dust as effectively as would a light shower every day.



"Substitute Nickel for Platinum! we can do Better *than that . . .*"

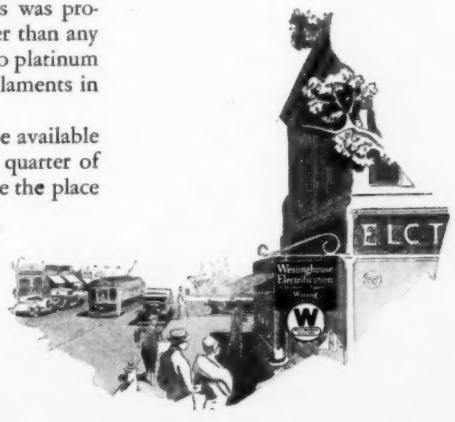
When the radio industry was young and only a few thousand technically minded enthusiasts were hooking up receiving sets, radio tubes were a laboratory product. The use of costly platinum-iridium for their filaments was not a handicap. For comparatively few tubes were in demand.

Westinghouse engineers, however, foresaw a serious situation. When millions of radio sets came into use there would not be enough platinum available to make the tubes they would need. A substitute material just as satisfactory must be found. Westinghouse laboratories set out to find it.

Soon a young engineer reported that nickel would meet the requirements. From a practical standpoint it made as good filaments as platinum. It would do. But Westinghouse engineers said: If a pure metal is as good as platinum, it should be possible to produce an alloy that will be far superior.

Months of tireless research and experimenting followed — development work that called into play the broadest scientific knowledge. Eventually the ideal combination of metals was produced, Konel metal, stronger than any alloy steel, and far superiot to platinum as a core for oxide-coated filaments in radio receiving tubes.

If sufficient platinum were available it would take more than a quarter of million dollars worth to take the place of the Konel metal used in vacuum tubes each month. And vacuum tubes are only one of its possible applications. Konel metal meets severe service requirements such as those confronted in gas engine valves and spark plugs. Its commercial possibilities have only been touched.



Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.

Westinghouse

Calcium chloride in its new "flake" form, is also finding growing application in the construction of concrete highways. It may be coated on the surface of the finished paving or added to the concrete mix. In the former case, the calcium chloride cures the concrete by supplying moisture—from the air—for the surface of the new road, thus preventing premature drying of the base as well as the surface. When the chemical is added to the concrete mix—two pounds, in solution, for every 100 pounds of cement—it eliminates all other forms of curing, such as straw covering, and gives a pavement that may be opened to traffic in one half the time required by the old methods.—*A. E. B.*

The Germ in the Blood

ORDINARILY the blood is free from germs. One may take specimens of blood and put them in a bacterial medium again and again and fail to grow a single germ from the specimen. In times of serious infection, however, germs get into the blood. Since the germs vary in their virulence and in their character it is, of course, desirable to know as soon as possible the type and the numbers of the germ involved. In order to settle this fact, various bacteriologic techniques have been developed, one of the most interesting having been devised recently by Dr. Reuben Ottenberg, who has developed the system called "differential blood cultures."

In system, blood is taken directly from the internal jugular vein, or from the arm vein, or perhaps from a vein directly draining the spot at which the germs are supposed to be developing. Another specimen is taken from a vein at a distant point and the number of germs in the blood taken from two or three places is compared on blood culture plates. If, for example, there is a severe infection of the mastoid or of the blood vessels on either side of the skull, the blood taken from the jugular vein on that side will contain many more germs than the blood taken from the arm vein or the leg vein in the same patient.

As is shown in the illustrations, the method works out satisfactorily and is of great value in making the diagnosis and in determining the procedure to be followed. Doctor Ottenberg applied the method in 29 cases with satisfactory results. Of course, the failure to find the germ in any of the cultures does not absolutely indicate its absence but may indicate the necessity for making a further study one or two days later.—*M. F.*

Launching and Picking-up Seaplanes

SO far, in using a seaplane in conjunction with a steamship, attention has been concentrated on specially prepared runways or on catapults. For picking up a seaplane from the water, cranes have been employed. *The Aeroplane* (London) points out that long runways are difficult to install, catapults are expensive, and fast steamers are not supposed to stop in the middle of a run.

Therefore an entirely new method of launching and picking up seaplanes, invented by a German engineer named Kiwull, is of decided interest.

The Kiwull "Watersail," as it is called, consists of a spread of canvas about 98 feet long and 33 feet wide, with spreader booms on the under side. One end of this canvas runway is attached to the deck over the stern of the steamship and the other end terminates in a kind of drogue made of wide-mesh netting. This end is attached to the ship by two ropes. The action of the drogue is to cause the water to roll in over the end. This makes it easy for the seaplane to taxi behind the steamer and run onto the trailing runway. When the seaplane is once on the runway, the floats are attached to skids and the whole machine is hauled up the inclined canvas slope. The process may be be reversed for launching.—*A. K.*

Calcium chloride, a snowy white chemical, coaxes moisture out of the atmosphere when it is spread on dirt roads. This deliquescence keeps the dust down because of the wetness. The chemical is also mixed with concrete to eliminate the costly process of watering the laid concrete or covering it with straw. Above is shown a calcium chloride spreader in action and at right a concrete mixer where the chemical is used

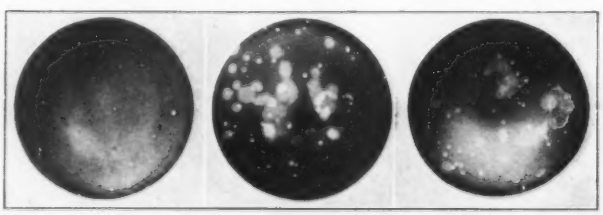
Hen Changes to Rooster, Then Changes Back Again

A HEN that became a rooster and then exercised the prerogative of her former sex and changed her mind, becoming a hen again, is the freak fowl described in the *Journal of Heredity* by Drs. R. A. McCance and A. Walton of the pathological department, King's College Hospital, London.

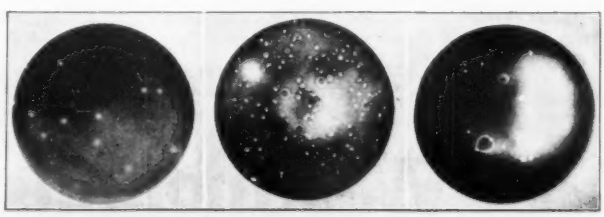
The bird, a light Sussex pullet, was hatched with seven other pullets in March, 1925. In October of the same year all eight commenced to lay and continued to do so until the spring of 1926. All then moulted and while the normal birds soon put on their new plumage, this freak remained practically nude all summer and autumn.

Early in 1927 she slowly assumed male plumage and grew spurs, but no comb. She also put on additional height, becoming two inches taller than her sisters.

She (or "he") commenced to rule the farmyard. She called the other hens to food, escorted them to the nest boxes, shepherded them about the yard, and in general conducted herself like the "cock



Blood plates ot a case of thrombosis of the left lateral sinus, showing: left, blood culture from left jugular; middle, from the right jugular; and right, from arm



Plates from a case of thrombosis of right lateral sinus, showing: left, culture from right jugular; middle, from left jugular; right, from arm—white spots are bubbles

of the walk." And she laid no eggs at all. In the autumn of 1927 she failed to moult with the others.

During the following spring she was seen going to the nests and clucking. A dozen eggs were placed under her as an experiment. Still wearing her male feathers, she faithfully sat on them, hatching out 11 chicks and proving an excellent mother afterwards.

Subsequently, still in male disguise, she began to lay eggs again. That autumn she moulted, resuming female feathers, but keeping her spurs. Throughout the winter of 1928 and spring of 1929 she laid regularly, mostly doubled-yolked eggs.

Usually when a hen reverses her sex, an examination of her internal organs will disclose some diseased condition, most probably in her ovaries. But when this hen-rooster-hen was killed and all of her glands subjected to minute examinations, nothing whatever could be found wrong with them. She remains an unsolved physiological riddle.

The editor of the *Journal of Heredity* adds a note telling of a somewhat similar case recorded a couple of years ago in this country. A hen assumed male feathers, but continued to lay. While she was still disguised as a rooster she was mated to a real White Leghorn male bird, and produced fertile eggs. She did not, however, raise her own family. Subsequently she moulted and her new feathers were those proper to her female sex.—*Science Service.*

Calcium Alloys Find New Uses

NEW commercial calcium alloys have been studied by Prof. J. Meyer, of Breslau, Germany, and are finding various uses. They are rather sensitive to air and moisture, forming a dense white smoke when burned. For some purposes the activation of calcium by sodium is of significance.

Chemical and Metallurgical Engineering reports that experiments by A. von Antropoff at Bonn have proved that minute quantities of metallic sodium at the surface of calcium can incite its reaction with nitrogen. Calcium filings can be activated by precipitated sodium fumes. The same investigators likewise report on the reaction of calcium and nitrogen in the presence of the rare gases, by which argon, for example, can be quickly and completely freed of nitrogen. The use of this process for the extraction of helium from natural gas seems to offer interesting possibilities.

Measuring Height in Seaplane Landings

A CABLE from London to the *New York Times* reads as follows:

"Experiments carried out at Calshot make night flying possible for seaplanes by means of small searchlights fitted beneath each wing. The rays converge at a predetermined distance from the plane, forming a large patch of light on the water and revealing exactly how far the pilot is above the surface when he is coming down."

It is quite difficult to estimate the height above water even in the day time, because definite points of reference are lacking. At night this is well nigh impossible. The cable needs a little interpretation, however.

If the small searchlights are placed under

Miles and Miles of Yellow Strand

This is the age of big projects—the deepening of waterways; the digging of great canals for transportation and drainage; the erection of mammoth dams to impound water for irrigation and power.

It is no mere coincidence that miles and miles of Yellow Strand Wire Rope are constantly employed in these enormous construction projects. The excavating and handling machinery are of the largest capacities obtainable—and each year finds them larger, putting ever increasing strains on their wire ropes. Only such rope as Yellow Strand can stand the gaff—economically.

Yellow Strand is designed and made especially for heavy duty. Its wire is drawn to our special specifications, from steel of Swedish origin. And over fifty years of wire rope making experience go into its manufacture.

One strand of yellow is its *visible* difference from all other ropes and enables you to *see* that you get Yellow Strand when you specify it.

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Eastern Office and Warehouse: **68 Washington Street, New York, N. Y.**
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Manufacturers of nothing but wire rope for over half a century.

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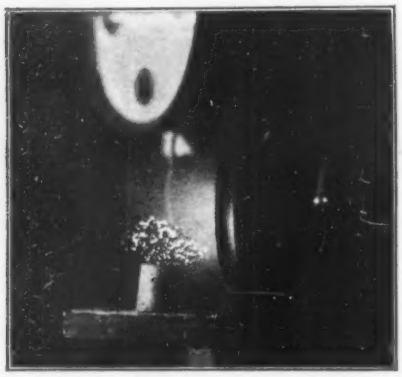
Yellow Strand WIRE ROPE

N792R57

each wing tip, at the proper angle to one another, their lights will indeed converge at a certain fixed distance from the wing. If the distance between the searchlights and the angle between them are both known, this distance is readily calculated. Now suppose that, by means of an inclinometer,



How minerals glow when subjected to the influence of cathode rays

we can tell the inclination of the plane to the horizontal. Then we can calculate its distance above the water. The naviagtor in these experiments probably sights the patch of light, reads the inclinometer, and picks off the height from a large and clearly visible chart mounted on the dashboard in front of him.

The device is only in its experimental stage, but is evidently correct in principle, and may be very helpful in the night flying of seaplanes.

Cathode Rays Detect Synthetic Jewels

SYNTHETIC sapphires can be detected readily from the natural stones by means of the cathode-ray tube. The use of the tube in this work is the first commercial application of the apparatus which was developed in the research laboratory of the General Electric Company by Dr. W. D. Coolidge about four years ago.

Sapphires, next to diamonds in hardness, are used by the company at the rate of more than a million and a half a year as jewels for bearings in meters and other delicate electrical instruments.

Trays of sapphires, both natural and synthetic, are exposed in a dark room to the powerful rays of the tube for a few seconds. All glow or radiate colors while exposed to the rays, but when the rays are turned off, the natural stones cease to glow whereas the synthetic stones continue to glow.

In addition to sorting the natural from the synthetic sapphires, the rays also help determine where both the natural or factory-made gems come from, an important advantage according to engineers.

"Should sapphires from Montana be mixed with stones from Australia, we could find this out with the cathode rays," B. W. St. Clair, of the company's standardizing laboratory at Lynn, Mass., explained. "In the case of synthetic stones, in most cases we can determine which factory made them by the different hue of the glow while the rays are on.

"We have one particular kind of natural sapphire which does not glow at all. In this case, the lack of glow under the rays immediately tells us its origin."

Tests have been made with diamonds and it has been found that synthetic stones turn decidedly brown when placed in the rays, whereas there is no change in natural stones. However, these tests have been but meager and no definite conclusions have been reached.

An Ice-Warning Thermometer

IN our July 1930 issue we described the very interesting experiments of Dr. Geer of Ithaca, whereby rubber, oil-impregnated airplane "overshoes" seem to have met the danger of ice formation. It still remains to be seen whether practical aviators will resort to these overshoes. Airmen have a horror of gadgets, and operators may fear that the added cost and a possible decrease in aerodynamic efficiency will be prohibitive. In the meantime it is the concensus that it is a very sound plan to warn the pilot that he is flying in a danger zone, namely where temperatures are between -4 degrees and O degrees, centigrade, and when he had better proceed to a zone of higher or lower temperature. A special instrument designed to warn the pilot of this danger zone is described by H. B. Hendrickson in *Instruments*. It is shown in the photograph. Essentially it is a temperature-actuated switch which controls a red light on the instrument board of the airplane.

Rough sapphires, synthetic and natural, are sorted by cathode rays

The thermal switch A is placed on the strut or other exposed part of the airplane, while the indicator box B is installed in a convenient place in the cockpit. The light behind the window in the indicator appears only at the above mentioned temperature range, -4 degrees to O degrees. For ease in installation on the ship, the instrument is made up in a unit with its own battery, using pocket flashlight cells of standard size, located in the box B.

The unit A in the illustration at the right is the thermal switch of the ice-warning thermometer. The box B is the indicator, and contains the battery

A bi-metal coil moves the switch, as the temperature decreases or increases and expands or contracts the coil. The contact points are made of coin silver. The lower contact is made crescent-shaped so that the switch arm can easily ride over it without jamming. When the temperature is in the danger zone, the switch assumes such a position that the circuit is closed and the battery lights the lamp.

Although the bimetal coil and contact points are enclosed to provide protection against the weather, tests show that the lag is not appreciable. Severe vibration does not interfere with the instrument.—*A. K.*

Mechanical Exercisers

DURING the past year there has been a great vogue for vibration and shaking of various portions of the body by the use of machines especially built for the purpose. These machines have been sold with claims that they would reduce weight, increase health, and in many ways take the place of exercise. Actually the machines are simply devices for producing passive motion in some part of the body. Moreover, cases have occurred in which the machines have been used by people with ulcers of the stomach and intestines or with swollen gall bladders, and the results of the agitation have been to burst the ulcer or to increase the inflammation and thereby to cause serious illness if not death of the patient.

The Council on Physical Therapy of the American Medical Association has recently issued a report governing the use of these devices. The Council argues that the point of view which their use develops in the patient is wrong. The advertisements and the instructions for their use often convey the impression that the machine will do the work necessary to cure the patient and that the patient does not have to work. Volitional effort is not encouraged, and the machine often is regarded as the only factor in the cure. The more expensive the apparatus or installation, the more this thought will be developed. These machines do not develop volitional effort of any kind—the work being done for and not by the patient. This develops a poor mental attitude in a patient and will react to his detriment.

These machines do nothing that can not be accomplished equally well by simpler apparatus or none at all. For example, many of these machines are sold to reduce excessive abdominal adipose tissue. In these cases the same results could be accomplished by leg and abdominal exercises without apparatus, with the patient giving himself heavy kneading massage at the same time that he is taking his exercises. In most cases, for general weight

reduction, much better results could be attained by a walk or a slow run in the fresh air.

These machines treat only one part of the body at a time and do not have the advantages of general exercise in developing other parts of the body. Vibratory massage of the abdomen with a strap attached to a motor for 10 minutes can not give as much benefit as does a 10-minute fast walk with conscious effort given to pulling in the stomach. The benefit of deep breathing, exercise of many muscles, and increase of circulation is actually obtained under the latter conditions.

The use of apparatus is stereotyped and monotonous. The physician prescribing one of these machines is making the same mistake that he would by prescribing only one form of massage or exercise. The patient will soon tire of its use. This form of massage vibration and shaking has little place in treatment, and better results could be secured by definite exercises varied enough to prevent monotony or by occupational therapy to prevent loss of interest.

The physiologic effect of mechanical exercisers is the same as of that form of massage which gives vibration and shaking. The effect of this form of massage has not the same effect as active exercises and can not have the same benefits.

The mechanical exercisers are often actually dangerous. The Council on Physical Therapy has records of severe injuries caused by these machines—ruptured appendix, hernias, ruptured bladder, ruptured duodenal ulcer, pleurisy with effusion, and torn penis.

The Council on Physical Therapy of the American Medical Association therefore condemns the sale of these mechanical exercisers to the public for the following reasons:

1. Volitional effort is not encouraged.
2. The same results could be accomplished without an apparatus.
3. Treating only one part does not give any of the advantages of general exercise.
4. The use of such apparatus is monotonous and the patient loses interest in treatment.
5. The effect is that of massage and lacks the physiologic benefits of exercise.
6. Such apparatus is definitely dangerous.—*M. F.*

Could Pave Broadway With Silver—But Won't

THE world production of silver for the entire period from 1493 to 1927, inclusive, has been over 14,000,000,000 ounces, or about 14 times the weight of gold produced in the same period, according to the United States Bureau of Mines, which has conducted an economic survey of the subject. This amount of silver would make a cube measuring 114½ feet on an edge; or it would pave Broadway, New York, six inches deep, from the Battery to Central Park, a distance of over four miles. Since 1888, more silver has been produced in the world than in the period 1493 to 1887; in other words the production of 396 years has been exceeded by the production of the last 39 years.

In spite of the greater relative increase in the production of gold than that of silver, the price of silver has declined. This decline in the price of silver has been a result of a lessening demand rather than an ab-

(*Please turn to page* 226)

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The Amateur Astronomer

Conducted by ALBERT G. INGALLS

NOW that cooler days to work in are in sight, it may be about the psychological time to think of building a private observatory to house the telescope for more comfortable use in the cold months. It seems odd that more amateur telescope

Pickering's housetop observatory

makers have not thus equipped themselves.

One of the best observatories is the simple straight-sided box type, equipped either with a slide-off roof or a traveling gantry roof as shown on the opposite page. However, there is this to be said: None of these straight-line "chicken-coop" types of structure look much like an astronomical observatory. The amateur may perhaps be pardoned if he prefers his neighbors and townspeople to know that the structure he creates houses a telescope.

To build the hemispherical type of dome

Yalden's design, turned cornerwise

requires no particular skill, though admittedly it involves considerable fussing and fitting. Designs vary widely. Usually the dome proper consists of a horizontal wooden ring and a number of upright curved ribs, covered with some kind of roofing and provided with a slot opening for the telescope. The whole dome is mounted on rollers and turns on the plate of the fixed building.

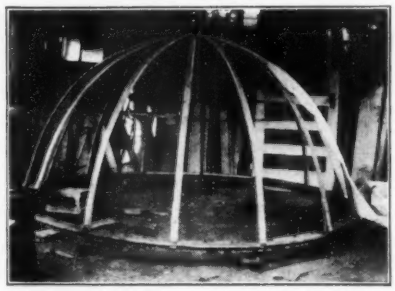
This building may be round or square, but many of those who have "been there,"

One of Schroeder's designs

and who speak from actual experience, will swear by the square type of building, because its four corners give room for a small built-in desk, for built-in seats, cabinets, bookshelves, and for a parking place for visitors, who sometimes get under foot in the more constricted, round type of observatory.

THE roof-top observatory of D. B. Pickering, of East Orange, New Jersey, the well-known variable star observer, is a good illustration of the square type. There is no mystery about the building proper, exclusive of the dome; it is simply a square structure built on top of the house. Note that the entrance is not through a trap door in the floor but from the roof through a door. This leaves the floor clear. Pickering did not run a masonry pier to the ground, as many think imperative, but rested the telescope pedestal on cross timbers attached to the roof. Will the vibrations of the house not destroy the good seeing? Pickering's success in variable star observing says at least, "not necessarily." The same bogey was faced when a large telescope was placed on the roof of a 13 story building at Columbia University, but the predicted ruination of seeing due to vibration did not materialize (*Popular Astronomy*, June–July, 1928; also same, Oct., 1926). Pickering saw to it, however, that the immediate flooring of his observatory did not touch the support of his telescope; he also insulated the floor against heat from the house below.

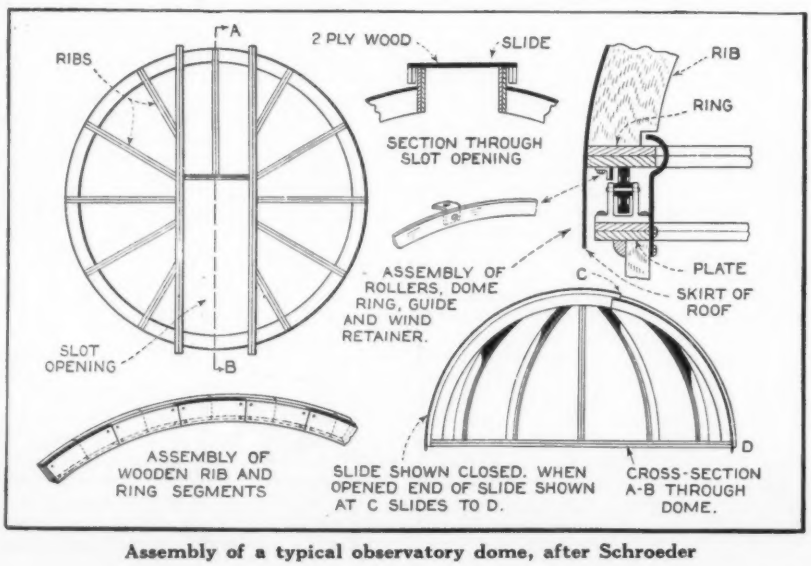
Another square type of observatory is that of George Waldo of Fairfield, Connecticut, designed by J. Ernest G. Yalden of 120 Woodbridge Place, Leonia, New Jersey, a variable star observer. This has a pyramidal "dome" which rotates on a



Light weight dome (by B. W. St. Clair)

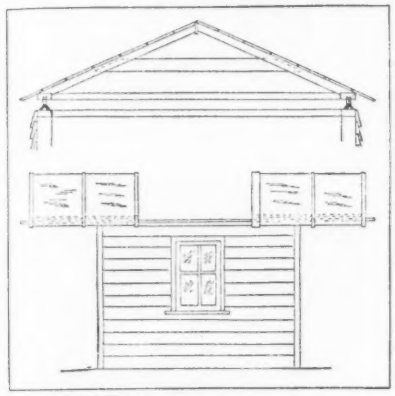
circular track. The side shutter lifts off, while the small level truncation at the top has a lid that tips back. By the way, the shutter should be at least 24 inches wide; a narrower one is a nuisance. It may, if one prefers, be made in two halves, like a sloping cellar door, opening outward.

ALBERT F. SCHROEDER, 1075 Forest Cliff Drive, Lakewood, Cleveland, Ohio, kindly let us see some drawings from which several observatories, including one



Assembly of a typical observatory dome, after Schroeder

in China, have been made. The original drawings can not be reproduced but the accompanying sketches based on them may serve to give ideas concerning a good structure. The main elements are: A solid circular track, for which wood, if leveled well, will do; about eight good rollers (Charles D. Higgs of Fontana, Wisconsin, used roller skate wheels—see *Popular Astronomy*, Aug-Sept. 1928); some kind of device or guide to keep these rollers on the track (here Mr. Higgs used eight more skate rollers bearing sidewise, while the sketch shows Schroeder's method); something to keep the dome from being lifted off by the winds, (Mr. Schroeder uses simple iron hoop stock bent to embrace but not touch the dome ring, as shown on sketch). The maker may juggle and recombine or revise these or other elements



Courtesy *English Mechanics*

W. R. Evans' design—gantry type

to suit his own taste. Past experience with amateur ingenuity in telescope construction gives promise of a wide variety of new ideas; some of which will be good and a few better yet. The average amateur dislikes being pinned down to a standard, inflexible design to copy. He prefers to do most of his own designing.

A good dome ring can be made of ⅛-inch pine stock cut to proper radius, lapped alternately, glued and screwed together. The vertical pieces are made in the same way. This makes a heavy dome, but one that will "stay put" in all weather. Any kind of roofing will do, from unsupported canvas, giving the "starved dog" effect, to sheet metal—suit your own skill, taste, patience and pocketbook.

SOME good hints and a few plans will be found in Bell's "The Telescope," Chapter 10, and others in various back numbers of *Popular Astronomy* (see A.T.M., page 260). In the average case, however, an ingenious amateur will prefer to "roll his own," thus giving him the right to take credit for the whole job. We have no "blueprints, instruction pamphlets, or set specifications" of any kind. Those who expect to hire a carpenter to do the job may need these, it is true; but if anyone plans to have it done in that manner the best thing is to go to a professional designer of observatories. The above, which is not too precise a description, was written for the fellow who enjoys doing his own jobs.

Amateur telescope making fans may be interested in knowing that the hobby is still going strong—stronger, in fact, than at any time since 1926. This is the first year in which interest has not dwindled to a tricklet during the hot months.

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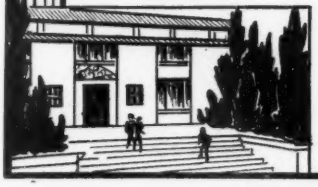

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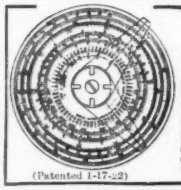

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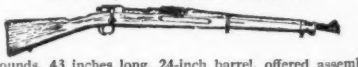

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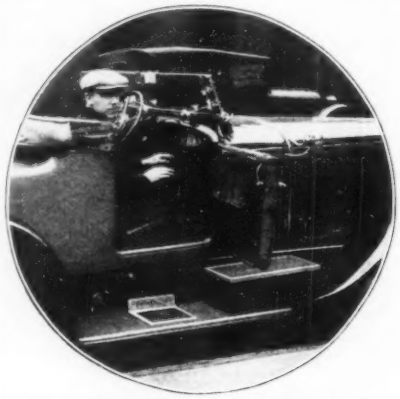
The Scientific American Digest

(*Continued from page* 223)

normally increasing supply. The lessening demand has been due very largely to demonetizing of silver during the latter part of the 19th Century by the principal nations of the world. Demonetization



The auto-radio receiver is mounted in a box on the running board

became possible through the enormous increase in gold production that followed invention of the cyanide process in 1887 and development of the gold fields of South Africa, yet a number of countries still retain the silver-gold standard. Most orientals use silver as a medium of exchange almost to the exclusion of gold. Silver may thus be regarded as a second line of defense for the maintenance of the metallic foundation of monetary systems, but the future of its production will be influenced largely by the production of gold.—*A. E. B.*

Gas Is Big Factor in Aviation Safety

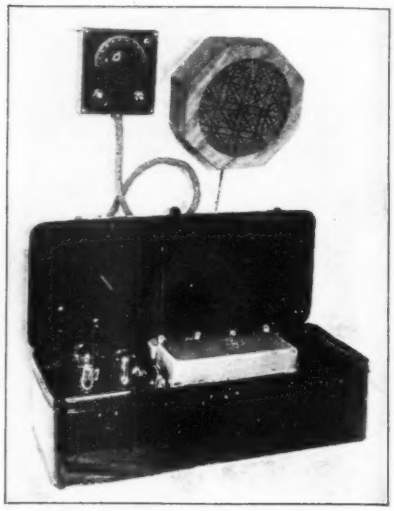
IN aviation a man's life literally "hangs by a thread," but the strength and importance of this "thread" depends on gas, according to *Industrial Gas.*

The manufacture of tie rods and tie wire for heavier-than-air machines relies largely on the steady, intense heat of huge gas-fired ovens. These parts, the "threads," are subjected to a temperature of about 300 degrees for six hours for the purpose of driving off any hydrogen that may have been absorbed by the steel wire. This process makes the wire strong and slender in order to assure the least possible air resistance.

Auto-Radio Kit

PRACTICALLY all of the automobile radio receivers that have appeared so far are intended for concealment behind the instrument board or under the engine hood. A new set in kit form, recently placed on the market by the Pilot Radio & Tube Corporation, is rather unusual in that it is designed for mounting on the running board, or possibly in the rumble seat of roadsters or coupés. The new outfit, bearing the name "Auto Pilot," is supplied in kit form and must be assembled, wired, and installed by the individual purchaser, who will find the work easy, interesting and enjoyable.

The receiving unit itself is contained in a black japanned steel case. This is 22 inches long, 8 inches wide, and 6⅞ inches high, flat enough to let the doors of all makes of cars clear it by a comfortable margin. The set is controlled from the inside of the car by means of a flexible cable

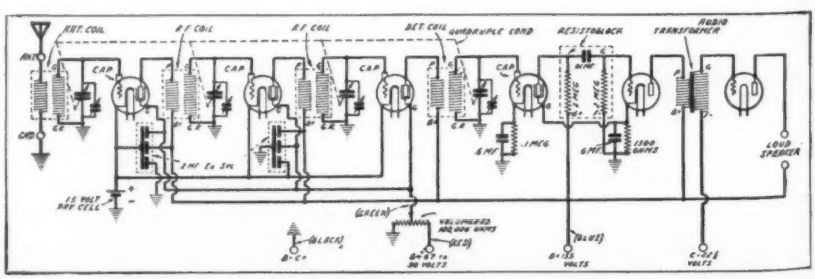


The assembled auto-radio in its box; the control panel that is placed in the car; and a small loudspeaker

which terminates at a control box 5½ inches square and 2 inches deep. The cable is six feet long and is enclosed in a protective sheath of waterproof fabric.

The movement of the tuning dial on the control panel is transmitted to the shaft of the variable condenser by means of two brass chains fastened to pulleys at both ends. These chains slide in separate flexible tubes, and run smoothly in spite of their length. The other devices on the control panel are the usual pilot light, volume control, and filament switch. The volume control is a potentiometer that regulates the voltages to the screens of the R. F. tubes.

Electrically, the receiver is of simple but reliable design. It makes use of three stages of tuned R. F., a screen-grid detector, one resistance-capacity audio stage and one transformer stage. All the parts are mounted on a formed and drilled



The circuit of the six-tube auto-radio receiver

aluminum chassis or foundation unit. Six tubes are employed: four 224's, one 227, and one 245. Plate voltage is supplied by three 45-volt "B" batteries.

The radio-frequency gain in this receiver is pushed quite high and little attention is given to selectivity because this matter is taken care of automatically by the necessarily small antenna that is used. For an aerial, a pair of wires strung between the front and rear axles, under the car, has been found very effective. Where the shielding effect of the chassis is too great, a piece of copper screening may be tacked to the inside of the top of the car, or a wire run around the edges of the running boards.

Air Swallowers

ONE of the most common American complaints is the swallowing of air, sometimes called "aerophagy." At least 60 percent of people with disturbances of the gastro-intestinal tract swallow air and belch. In fact, the habit is not associated merely with modern man, since it is referred to in the writings of the ancient Greeks and Romans, including Martial and Petronius. Among the causes particularly for the swallowing of air and its return are rapid eating, gulping of food, and involuntary swallowing of air during breathing. With almost every swallow of food or saliva air enters the esophagus and is either eructated at once or goes into the stomach.

Dr. Asher Winkelstein has given special attention to this trouble, and mentions the fact that there is one group who voluntarily swallow air in large quantities and expel it at all times and in all places. These people are usually neurotic and perhaps indulge in this performance as a means of expressing themselves.

Another group has various forms of gallbladder, intestinal, heart, or liver disease, with a constant sense of pressure in the abdomen. Having learned that belching will relieve their sense of pressure in the abdomen they swallow air, belch, and thus temporarily obtain a sense of relief. When air is swallowed, it is trapped in the stomach by a contraction of the end of the

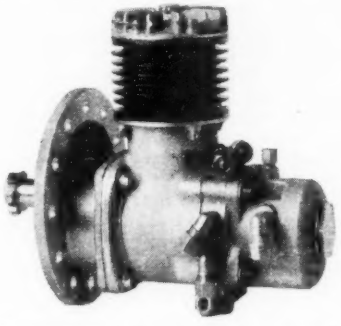
X ray shows the distended stomach and intestines of an air-swallower

esophagus and by a spasm of the pylorus through which the stomach empties into the intestines. It requires some time or activity to cause the air to leave.

In the control of the condition, Doctor Winkelstein recommends the training of habits so that air will not be swallowed, the use of mild sedative substances, and occasionally instrumental dilation of the end of the esophagus which has not only the instrumental effect but the possibility of powerful psychologic effect. It is, of course, necessary for the physician who examines such a patient to determine definitely that this symptom exists and not anything more serious as, for example, heart disease, intestinal obstruction, or fermentation.—*M. F.*

The Heywood Injection Starter

SWINGING the airplane propeller in order to start the engine will soon be entirely a thing of the past. The dangers and discomfort of swinging have been replaced by starters of various types—electric, inertia, hand, and pressure-injection types. The Heywood starter, of the latter type, built by the Sky Specialties Corporation, has been fitted successfully to many engines and in many planes.



Compressor of an injection starter

The Heywood starter consists of a small air compressor, a steel tank, a pressure regulation valve, a starting valve, inlet valves for each of the cylinders, tubing, pressure gage, and primer. The weight of the starter is about 30 pounds.

The small air compressor, shown at the top part of the accompanying photograph, is driven off the rear of the engine shaft, requires only one quarter of a horsepower, and can refill the starting tank in one minute.

The tank (not shown in the illustration) has a capacity of about one half of a cubic foot, and holds air at 400 pounds per square inch pressure.

When starting the engine, the pilot primes in the usual way, but the gasoline does not go directly to the cylinders or the manifolds of the engine, but into a small gas chamber on the starter where it is held until the starter trigger is pulled.

After the ignition is switched on, the starter trigger is pulled. The trigger allows the air to be released from the tank and to go to a chamber in the starter where it is routed by means of a rotating disk that is timed on its shaft with the engine. This rotating disk has one large and one small hole, and rotates close to a stationary disk that has as many holes as there are cylinders in the engine. The large hole in the rotating disk registers with the appropriate hole in the stationary disk and allows the compressed air to go through to the cylinder which is in position for a power stroke. This starts the engine in rotation.

Simultaneously, part of the air in front of the rotating disk goes to the gas chamber, and forces the gasoline through a small

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A complete description, accompanied by blueprints, if possible, should accompany your reply, which we will forward to the company, where it will be seen by one man, a major executive, and held in extreme confidence.

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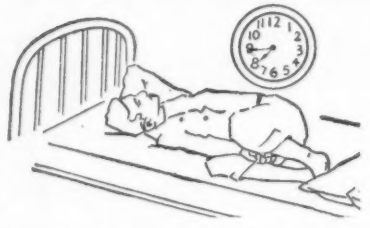

Are you *sure* that you "slept like a log" last night? Or, would a moving picture machine reveal you rolled up like a ball, twisted like a rope or hanging over the side of the bed like a line of clothes? Drs. Johnson, Swan and Weigart took movies of 150 sleepers. The results were astonishing. They showed that a soundly sleeping, healthy man may struggle through forty or fifty different positions nightly, not one of which will be held more than an hour. A description of this extraordinary, scientific experiment, with pictures of 33 "sleeping beauty" postures appears in the September HYGEIA, the Health Magazine of the American Medical Association. It is a real contribution to an all important subject.

COLDS *and The Other Fellow*

You have heard that colds are contagious, and you would like to know just how they are spread so that you can allay unnecessary fears and sensibly avoid the cold-infection. The September HYGEIA contains a timely discussion, by Dr. Rachael Ash, especially directed to parents and teachers, explaining the way colds spread and how to keep yourselves and your children from catching the debilitating cold germ—a most helpful article with the cold season just around the corner.

Other Vital Features in HYGEIA

"How Much Should the Patient Know"—"The Tardy but Tempting Tomato"—"The Movies in Medicine"—"The Undernourished School Child"—"Questions and Answers"—these are only a few of the features of the September HYGEIA. Every article is written by an authority who proves theory with practice. The language of HYGEIA is non-technical, simple and even entertaining. Every issue is a gold mine of reliable health information. As you value your health you will value HYGEIA.

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carbureter nozzle that projects into the center of the rotating disk and up to the small hole that also registers with a hole in the stationary disk, and allows gas to flow to the appropriate cylinder.

There is therefore simultaneous rotation of the engine and injection to the cylinders from a small gas supply of a richly carburetted mixture. The starter rotates the engine at 400 to 500 revolutions per minute.

It is claimed for the starter that it will function under almost any weather conditions, that it does away with the danger of back-firing, and that it is simple, dependable, and easy to operate.—*A. K.*

Explosions in the Laboratory

THE hazards of industry are seldom considered as concerning the research worker in the laboratory. Nevertheless, the chemist, the pathologist, the bacteriologist, and indeed even the physicist are constantly working with chemicals, germs, poisons, and electrical materials which can put them in jeopardy. Dr. John A. Marshall has reported an unusual incident in the laboratory in the University of California devoted to the staining of tissues.

In the incident reported, sections of bone and teeth were being stained by the silver nitrate method. The dishes containing a solution of ammoniacal silver oxide were left standing in the sun from Saturday noon until Tuesday morning. There were traces of alcohol in the silver solutions, carried there by the pieces of tissue which had been previously immersed in alcohol. The sunlight hastened the chemical change between the silver, the chemical, and the alcohol. As a result a highly explosive, sensitive, and unstable compound called silver fulminate developed. When the dish was taken up to be emptied and cleaned, it was warm from the sun and the mere movement of the liquid caused the fluid to explode.

As a result the warning is issued that one should never work in the direct sunlight with silver solutions or leave bottles or dishes containing them exposed. Every precaution must be exercised to keep out ethyl alcohol, and containers for silver solutions should be immersed promptly and carefully in cold water.—*M. F.*

Inventor of Ethyl Gasoline Scores Again With New Refrigerant

THE "big news" of the recent meeting of the American Chemical Society in Atlanta was the announcement of a new refrigerant, non-inflammable and non-toxic, by Thomas Midgley, Jr. Anything that Midgley announces is apt to be big news, for he has a way of striking out on entirely original lines and developing something that boosts General Motors stock. Midgley is the chemist who discovered the anti-knock properties of tetra-ethyl lead, and he was the first president of the Ethyl Gasoline Corporation. Now he has turned his genius to the perfecting of a refrigerating medium that his company can use in household electric refrigerators without the remotest risk of danger from leaky coils. His discovery of the suitability of dichlorodifluoromethane gives promise of the early use of refrigeration for air cooling in homes and theaters and other public gathering places where refrigerating engineers have hesitated to risk accidents with poisonous or explosive refrigerants.

Dichlorodifluoromethane is made from carbon tetrachloride (a common fire extinguisher) and antimony trifluoride. Human beings and animals can inhale vapors of dichlorodifluoromethane without the least ill effects. It is not only non-inflammable, but it is actually a good fire extinguisher. Of course, it is stable and possesses the necessary vapor-pressure characteristics for a good refrigerant. It boils at -30 degrees, centigrade, and freezes at -155 degrees, centigrade. It is non-corrosive with steel, aluminum, copper, tin, and monel metal.

Thus, while proponents of diverse standard refrigerants were arguing the question of which was the safest and best, Mr. Midgley settled the question in characteristic style by creating a new one which left no grounds for argument.—*A. E. B.*

The Future of the Aviation Industry

THE Curtis Publishing Company has recently issued a magnificent book summarizing a long and thorough survey of the aviation industry. The study is most comprehensive, covering planes, schools, markets, speed, comfort, air transport, financial, and many other aspects of the industry. The material presented is accurate but not new. What is valuable is the conclusions of careful and independent observers as to the "underlying trends." These conclusions appear in the very first chapter and are of interest to any one who is at all concerned with the future of American aviation. We quote from this chapter in part:

"We have confidence that the aviation industry will develop into a large and sound industry. This confidence is based on two facts. First, the idea of air travel is sound. Air travel is certainly the quickest, we believe it can be made the most comfortable, and ultimately we think probably the least expensive method of long distance travel."

"Enthusiastic service appears to be more true of aviation than any other form of transportation and also more true of aviation than of any other industry we have studied. . . ."

"It seems to us likely that ultimately all first-class mail will be carried by airplane wherever an airplane can speed delivery; that a majority of 'Pullman class' day travel for distances in excess of 100 miles will be by air; that air package transport may exceed first-class mail and passengers combined."

The report is equally enthusiastic about the possibility of privately owned planes having a large market. The findings are qualified, however: "If through the autogiro or some other principle, it comes about within the next five years, that planes when they lose speed will settle to the ground without damage, if they can be taken safely into and out of a four-acre lot, and if a person with average mechanical training can in a short time at small expense learn to fly a plane safely, and if, furthermore, planes are sold at prices comparable with automobile prices, within fifteen years, there should be 1,000,000 privately owned planes in operation with an annual market of 250,000." This view defines at least the problem before our constructors and they will certainly do their utmost to meet the challenge successfully.—*A. K.*

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

WILL THE WOOD INDUSTRIES OF AMERICA FOLLOW BEATEN PATHS OR BLAZE NEW TRAILS deals with potentialities of cellulose and lignin. The rise in the production of wood plastics has been phenomenal. *National Lumber Manufacturer's Association, Transportation Building, Washington, D.C. —Gratis.*

THE AMMONIA-CHLORINE TREATMENT OF WATER by J. F. T. Berliner is a digest and bibliography of the subject. *National Ammonia Company, Inc., Frankford P. O., Philadelphia, Pa.—Gratis.*

THE OBSTACLES AND PITFALLS OF INVENTORS, by Joseph Rossman, Ph. D., gives the views of a chemical engineer who is an Associate Patent Examiner, U. S. Patent Office. *Address Joseph Rossman, U. S. Patent Office, Washington, D. C.—Gratis.*

WORKING PROPERTIES OF TANTALUM (Technical Publication No. 278, Class E, Institute of Metals, No. 105. The American Institute of Mining and Metallurgical Engineers) by M. M. Austin. *American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City.—25 cents.*

SCIENCE IN THE KITCHEN (Radio Publication No. 58, University of Pittsburgh) consists of a series of popular radio talks broadcast by research specialists of the Mellon Institute for Industrial Research, Pittsburgh, Pa. *Radio Manager, University of Pittsburgh, Pittsburgh, Pa.—60 cents.*

TWENTIETH CENTURY WHALING (Bulletin New York Zoological Society, Jan.-Feb., 1930. Vol. XXXIII. No. 1,) by Dr. C. H. Townsend, is a splendid discussion of an ever popular subject written by the Director of the New York Aquarium. *New York Zoological Society, Zoological Park, Borough of the Bronx, New York City.—35 cents.*

FLORA OF THE INDIANA DUNES by Donald Culross Peattie is a handbook of the flowering plants and ferns of the Lake Michigan coast of Indians and of the Calumet district. This 432 page book will be a boon to all who visit this locality. *Field Museum of Natural History, Chicago, Ill.—$2.20, mailed.*

AIRPORTS IN LATIN AMERICA (Trade Information Bulletin, No. 696, U. S. Department of Commerce) is a bulletin describing the airports, landing fields, and weather conditions in 26 countries of Latin America. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

AUTOMOTIVE EQUIPMENT AND CONSTRUCTION PREFERENCES IN FOREIGN COUNTRIES (Trade Information Bulletin, No. 695, U. S. Department of Commerce) is a bulletin noting many changes in foreign preferences as regards automobile construction, equipment, and color. *Superintendent of Documents. Washington D. C.—10 cents (coin).*

CORN IN KANSAS (Vol. XLVIII. No. 191, Report of the Kansas State Board of Agriculture for the Quarter Ending September, 1929) is the subject of this fully illustrated 283 page book. While it is intended primarily for distribution among Kansans, outside requests are honored where the book is really desired. *Address J. C. Mohler, Secretary, Kansas State Board of Agriculture, Topeka, Kansas.*

CORROSION OF ALLOYS SUBJECTED TO THE ACTION OF LOCOMOTIVE SMOKE (Technical Publication 293 Class E, Institute of Metals, No. 104) by F. L. Wolf. *American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City.—25 cents.*

REPTILES OF MARSHALL FIELD NORTH ARABIAN DESERT EXPEDITIONS, 1927-1928 (Publication 273 Zoological Series, Vol. XVII. No. 6) by Karl P. Schmidt. *Field Museum of Natural History.—25 cents.*

THE SOVIET AND RELIGION (No. 261 of International Conciliation) contains the debate in the House of Lords, decree of All-Russian Control Committee, and the Protest of His Holiness Pope Pius XI. *Carnegie Endowment for Industrial Peace, 44 Portland St., Worcester, Mass.—5 cents.*

LUBRICATION OF HYDRAULIC POWER GENERATING EQUIPMENT (Vol. 16, No. 5 of Lubrication May, 1930) describes the problems of oiling these ponderous machines. *The Texas Company, 135 East 42nd St., New York City.—Gratis.*

PROPERTIES OF HAYNES STELLITE is the first of a series of booklets embracing Haynes Stellite products, their uses and methods of application. *Haynes Stellite Company, Kokomo, Indiana.—Gratis.*

THE 92 ELEMENTS is a folder giving their numbers, names, symbols, atomic weights, melting points, and years of discovery. *P. C. Kullman & Co., 110-116 Nassau St., New York City.—Gratis.*

ACUTE RESPONSE OF GUINEA PIGS TO VAPORS OF SOME NEW ORGANIC COMPOUNDS. I. ETHYLENE DICHLORIDE (Reprint No. 1349 Public Health Reports, Public Health Service, U. S. Treasury Department) by R. R. Sayers, W. P. Yant, C. P. Waite and F. A. Patty. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

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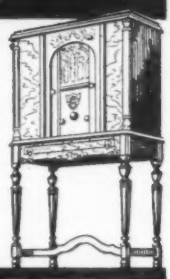

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DIAMOND CORE DRILL FITTINGS (Commercial Standard CS17-30, Bureau of Standards, U. S. Department of Commerce). *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

AN ANNOTATED LIST OF THE MORE IMPORTANT NORTH AMERICAN FOREST INSECTS (Miscellaneous Publication No. 74) by F. C. Craighead and William Middleton, gives a list of insects and the damage they do. There is an excellent bibliography. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

DIRECT BONE FORMATION IN THE ANTLER TINES OF TWO OF THE AMERICAN CERVIDAE, VIRGINIA DEER AND WAPITI (Zoologica, Vol. XI, No. 3) by Charles V. Noback, Ph.D., and Walter Modell, B. S. *New York Zoological Society, Bronx Park, New York City, N. Y.—65 cents, mailed.*

TIMBER GROWING AND LOGGING PRACTICE IN THE NORTHWEST (Technical Bulletin No. 166, U. S. Department of Agriculture) by Samuel T. Dana, with an introduction by William E. Greeley, treats of the measures necessary to keep forest land productive and how to produce full timber crops. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

VITREOSIL deals with vitreous silica and forms a valuable treatise on fused pure quartz and fused pure silica. *The Thermal Syndicate Limited, Schenectady and Atlantic Avenues, Brooklyn, N. Y.—Gratis.*

STUDIES IN THE ELECTRO-DEPOSITION OF METALS (University of Illinois Bulletin No. 206, Engineering Experiment Station, Urbana, Ill.) by Donald B. Keyes and Sherlock Swann, Jr. *University of Illinois, Urbana, Illinois.—10 Cents.*

PROPAGATION OF AQUATIC GAME (Farmer's Bulletin, No. 1612, U. S. Department of Agriculture) by W. L. McAtee. Full information regarding a small but growing industry, fully illustrated. *Superintendent of Public Documents, Washington, D. C.—10 cents (coin).*

MANUFACTURE AND PROPERTIES OF A CELLULOSE PRODUCT (MAIZOLITH) FROM CORNSTALKS AND CORN COBS (Miscellaneous Publication No. 108) by C. E. Hartford, describes the utilization of agricultural wastes. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE RELATION OF CARBON RESIDUE TO LUBRICATING PERFORMANCE. Lubrication, January, 1930. *The Texas Company, 117 Battery Place, New York City.—Gratis.*

FOUNDRY PATTERNS OF WOOD (Commercial Standard CS19-30, Bureau of Standards, U. S. Department of Commerce) contains a fine plate giving standard pattern colors. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

LABORATORY TESTS OF REINFORCED CONCRETE ARCH PILES (Bulletin No. 202, Engineering Experiment Station, University of Illinois) by Wilbur M. Wilson. *University of Illinois, Urbana, Ill.—55 cents.*

WEATHER AND HEALTH (Bulletin No. 75 of the National Research Council) by Professor Ellsworth Huntington is a scientific effort to determine the relation between weather and health. *National Research Council, Washington, D. C.—$2.00.*

WARNING AGENTS FOR METHYL CHLORIDE IN REFRIGERATION SYSTEMS is a contribution to the household refrigeration industry from the *Roessler & Hasslacher Chemical Co., 10 East 40th St., New York, N. Y. —Gratis.*

SLOPE CORRECTIONS FOR ECHO SOUNDINGS (Special Publication No. 165, Coast and Geodetic Survey, U. S. Department of Commerce) by A. L. Shalowitz, deals with the "fathometer" invented by Dr. Reginald A. Fessenden and the proper corrections to be made. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

DURABILITY TESTS OF SPAR VARNISH (Bureau of Standards Reprints, No. R.P. 146). *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

A YOUNG MAN LOOKS AT THE EASTMAN KODAK COMPANY gives a quick glance at a great industry and the opportunity that it offers to ambitious men. *Published by the Training Department of the Eastman Kodak Company, Rochester, N. Y.—Gratis.*

SICKNESS AMONG INDUSTRIAL EMPLOYEES (Reprint No. 1347, Public Health Reports,) by Dean K. Brundage. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

TRIANGULATION IN COLORADO (1927 Datum) (Special publication No. 160, Coast and Geodetic Survey) by Oscar S. Adams. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

MINING IN THE FORTYMILE DISTRICT ALASKA (Bulletin 813-C, Geological Survey, Department of the Interior) by J. B. Mertie, Jr. *Superintendent of Documents—Washington, D. C.—5 cents (coin).*

INTERNATIONAL TRADE IN MICA (Trade Promotion Series No. 95, U. S. Department of Commerce) gives valuable information about this type of mineral deposit. *Superintendent of Documents, Washington, D. C. 10 cents (coin or money order).*

Our Point of View

The International Bank

(*Continued from page* 175)

contention among world powers is a reasonable certainty to all acquainted with European history.

If this new bank cuts deeply into the profits of central banks of England, Germany, and France, its existence may be brief. Pretexts for its dissolution could quickly be produced. Its attitude during war, or even a period of strained relations between European powers, would be difficult if not impossible. Most of its optimistic founders calmly ignore the possibility of future European wars in forecasting its future, but war comes unbidden to most of his hosts.

We welcome the new bank and are proud that American bankers were its originators. Undoubtedly American membership on its staff will involve us still further in world affairs, but we are so thoroughly involved already that the new bank adds little to our commercial ties with Europe and nothing to our political responsibilities.

CIVIL AND MILITARY AUTHORITIES

THE time is near when our civil authorities will be obliged to pay more heed to their military and naval advisers than they have in the past, else the interests of the United States will suffer. The substance of the defense of the naval treaty by our delegation was that "it was the best we could get because both Japan and England had out-built us, and naturally we could not expect them to scrap ships already built or building." Yet in 1921, Mr. Hughes, ostentatiously refusing to consult with our naval officers, did scrap our battleships and battle cruisers. Americans should remember that, under the auspices of Mr. Hughes, we were willing to sacrifice naval superiority in 1921-22; and in 1930, Japan took advantage of her actual naval position to upset the naval ratio between the two countries. We will be under a handicap during the life of this treaty but we can overcome it easily in the period 1935-40 if we have really learned the obvious lesson.

OUR NEW MERCHANT MARINE

ONE of our few industries that is doing better in 1930 than in 1929 is shipbuilding, and for this we can thank the recent legislation by Congress, specifically designed to encourage the rebuilding of an American merchant marine. Four of our largest shipbuilding companies show an increase of 21 percent in the number of men employed. This increase is spread through all the skilled trades and crafts needed in the construction of a modern sea-going vessel. The support of Congress was extremely timely for under the severe competition of foreign companies that can build and operate vessels with cheaper labor, our shipyards were being abandoned and the many trained artisans necessary to that industry were being dispersed to other trades.

Efficient shipyards and skilled shipwrights are essential to our foreign trade in peace and to our fleet in war. Other nations give much care to their shipbuilding industry. Thus, at the London Conference, Japan insisted that she be allowed special permission to replace some of her submarine tonnage before it become obsolete in order to insure permanent employment to her trained shipbuilders. If with her present financial burdens, Japan can subsidize her shipyard workers, we can certainly afford to reassemble our workers before they are entirely absorbed into other trades.

FRENCH EVACUATION OF THE RHINELAND: INCREASE IN ITALY'S MILITARY FORCES

ALMOST simultaneously with the announcement of the evacuation of the Rhineland by the French forces in accordance with the provisions of the Dawes-Young plan for reparations, comes the news of further increases by Mussolini of Italy's land, sea, and air forces. At first glance these two occurrences may seem a mere coincidence, but it is well known in Europe that France does not wish to confront Italy with a large part of her army in Germany. With Italy scarcely concealing her conflicting ambitions, France naturally hastens to reduce her differences with Germany, re-group her armies, and strengthen her Italian frontier. Franco-Italian jealousy may prove a blessing to Germany.

To view further the already complicated European picture, in parts of Jugoslavia anti-Italian demonstrations have taken place. Americans can scarcely imagine the war-scourged Serbians considering another resort to arms so soon, but Mussolini regards the French-Jugoslavian menace sufficiently real to increase Italian taxes to add to his armed forces. As Mussolini has heretofore steadily reduced imposts on his heavily burdened people, the significance of this increase is apparent.

THE SEA FRONTIERS OF THREE NAVAL POWERS

THE London Conference called the world's attention to a wet triangle that can be somewhat loosely inclosed by lines drawn from the south point of Formosa to Guam, thence to Hong Kong, then returning to Formosa. This area of mixed land and water includes the sea frontiers of the three naval powers, Japan, Great Britain, and the United States. In a political sense, this wet triangle resembles the "buffer states" of a generation ago, the most famous being the Balkan States whose boundaries were fixed by various European conferences to reduce the risk of war between the three land empires, Russia, Austria and Turkey.

A glance at a world chart will reveal the importance of this area navally and commercially. It controlls the routes from the Far East to Europe and to Australasia, and the routes from the west coasts of the Americas to the Philippines, Southern Asia, and India. For this reason, Great Britain insisted upon the right to create an impregnable first-class naval base at Singapore, when at the Washington Conference Japan succeeded in restricting any further fortifications at Hong Kong or Manila. We did not appreciate the necessity of naval bases for our fleet and in consequence, our nearest naval base, Honolulu, is almost 5000 miles distant. It is hoped that our Delegation to the Naval Conference in 1935 will go with a mandate to redress the naval balance in this area.

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Books Selected by the Editors

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EXPLORING FOR PLANTS—*By David Fairchild*

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STANDARDS AND STANDARDIZATION—*By N. F. Harriman, Bur. of Standards*

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Similar Food Trademarks Allowed

IN a recent decision, First Assistant Commissioner Kinnan held that the Lush'us Products Company, of Chicago, Illinois, is entitled to register as a trademark for canned peas, a composite mark consisting of the representation of a chef holding a dish of peas in one hand and lifting the cover of the dish with the other, together with the words "Lush'us Peas," which words are disclaimed, notwithstanding the prior adoption and use by the California Canneries Company of the term "Lusk's Luscious" as a trademark for canned fruits and vegetables.

The ground of the decision is that the two marks have nothing in common but the descriptive word "luscious" and since no one is entitled to the exclusive use of the word, there is no likelihood of confusion by reason of the use of the two marks.

After stating that the word "luscious" was obviously descriptive of the goods and it is a matter of common knowledge that it has long been applied to both fruits and vegetables, the First Assistant Commissioner said:

"No one is entitled to exclusive appropriation of the word. The opposer is only entitled to exclude others from using this word in the particular and distinctive way it has used the word on its goods; that is, in connection with the word 'Lusk's.' The applicant is likewise entitled to use this word, misspelled as it is shown, in connection with the other distinctive features which constitute the entire mark. This descriptive word, which is open to everyone to use in connection with the goods of this character, being the only feature of similarity between the two marks, it is believed the opposer cannot prevail."

Concrete Mixer May Be Beautiful

THE Court of Customs and Patent Appeals has held that a specific design for a concrete mixer truck body and frame constitutes proper subject matter for a design patent, and has overruled the decision of the Patent Office refusing an applicant a design patent, according to *The United States Daily*.

The beauty and ornamentation requisite in design patents is not confined to such designs as may be found in the "esthetic or fine arts," the majority opinion states. Tools and mechanisms which are patentable because of their utilitarian qualities, it was further ruled, also may be properly the subject matter of design patents if they possess qualities which the law requires.

Articles of manufacture, the ornamentation of which, owing to their nature, are of no concern to anybody, are not proper subject matter for design patents, the majority opinion states, but held that the particular article did not come within this class.

While the concrete mixer has movable parts, there is nothing connected with the mechanism, or with the machine as a whole, which produces such a multiplicity of designs, the opinion states, as to require the refusal of a design patent.

In the dissenting opinion, it is contended that the design disclosed and claimed does not represent patentable subject matter. "It has escaped our observation," the two members of the court state in their dissenting opinion, "if the pulchritude of articles like concrete mixers has ever excited any great public consideration."

Bottle Cap Not Mark for Milk

RECENTLY First Assistant Commissioner Kinnan held that the Walker-Gordon Laboratory Company, of Plainsboro, New Jersey, is not entitled to register, under the Act of 1905, as a trademark for milk, a mark defined as consisting of a "substantially silver colored cap for milk bottles."

The ground of the decision is that the alleged trademark is a mere color of the container of the goods or a substantial part thereof.

In his decision, after noting the grounds above stated, on which the examiner refused registration, and applicant's argument that, by reason of its long use of such colored bottle caps, that color constituted a trademark, the First Assistant Commissioner said:

"It is well settled that mere color aside from some particular symbol or design, such, for example, as a circle, square, triangle, cross, or star, cannot constitute a valid trademark. (Decisions cited.) There is no contention here that it is new to employ a metal cap upon a milk bottle which is attached to the bottle by being bent down over the top much in the way the applicant uses the cap. This being true the applicant is merely seeking a trademark for the color of the cap of the bottle which contains the goods."

The First Assistant Commissioner further noted patent No. 531,796, disclosing and claiming a "tin-foil cap for milk bottles," and said:

"Since tin-foil is either what the applicant here employs or is substantially the same and has a substantially silver color, the registration sought by the applicant would, if granted, be in effect a perpetual patent upon a tin-foil milk bottle cap. The Hall patent expired 18 years ago. If registration were granted the applicant neither Hall nor the public could use the device of that patent without infringing the applicant company's trademark. It is obvious enough under these conditions registration must be refused."

Fly Sprays to be Correctly Labeled

FLY sprays for animals are not "100 percent effective," or "safe," or "nonpoisonous," or "harmless," and neither do they "prevent infectious diseases," nor do they "increase milk production" above normal, and if they are claimed to be effective for longer than 8 hours they are open to question, says Dr. C. C. McDonnell, in charge of insecticide control, Food, Drug, and Insecticide Administration, the organization of the U. S. Department of Agriculture which enforces the Federal Food and Drugs Act, the Federal Insecticide Act, and other Federal regulatory laws.

"There is a marked difference in the action of sprays on various species of flies, and broad claims to the effect that a product is effective for all flies are unwarranted," says Doctor McDonnell. "In defining the action of fly sprays, a distinction should be made between preparations that actually kill flies and those that only repel them."

Not only must the label on fly sprays be free from false or misleading statements, but if the product contains any inert ingredients the label must state the name and percentage of each inert ingredient, or the name and percentage of each active ingredient and the total percentage of inert ingredients.

Name for Glass Must Not Mislead

USE of the word "Jena" either independently or in conjunction with the word "Glass" will be discontinued by a corporation in the sale of medicinal supplies and syringes designed for use by the medical profession.

According to a stipulation agreement between this corporation and the Federal Trade Commission, the company will not use the word "Jena" in any way as descriptive of its product so as to mislead the public into the belief that its product is Jena glass, which is understood by the scientific and professional world to be that glass manufactured by a competitor of the respondent company.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Refrigerator Trademarks Clash

IT has been held by Assistant Commissioner Moore that the McKee Refrigerator Company is not entitled to register, as a trademark for refrigerators, the term "Iced-Aire," both because it is confusingly similar to the term "Frigidaire" previously used by the Frigidaire Corporation, of Dayton, Ohio on the same goods and because it is descriptive of applicant's goods.

In his decision, after noting the holding of the examiner of interferences that the notation Frigidaire is descriptive and therefore not owned by the opposer, and the use of that notation would not therefore support a claim to damage, the Assistant Commissioner said:

"That it is not necessary, in order to sustain an opposition, that the opposer shall own the trademark, registered or not, before he can oppose the registration of the mark to another person, has been held in many decisions, both by this office and by the Court of Appeals of the District of Columbia. . . . A comparison of the two marks shows that they both have the same ending and the same suggestive meaning, namely, that the air as in a cold state. While the word Iced and the word Frigid do not look alike, yet it is believed that, since they convey the same meaning, their concurrent use on refrigerators would be likely to cause confusion or mistake in the mind of the public as to the origin or ownership of the refrigerators to which the marks are appropriated."

With reference to the character of the marks, after stating that the examiner of interferences did not exceed his authority in holding the word descriptive, he said:

"The mark Iced-Aire, when applied to refrigerators, would convey no other meaning than that the air is rendered cold by the application of ice, and, if the applicant's refrigerator does not operate on this principle, then the mark is deceptive and, in either case, should not be registered."

"Special" Price Must be Special

MISREPRESENTATION of the regular price of a course of instruction as a "Special" price, will be discontinued by an individual engaged in the sale and distribution of certain formulae and courses of instruction in resilvering and replating metal goods, the respondent having signed a stipulation agreement to this effect with the Federal Trade Commission.

Specifically, he agrees to cease and desist from the use of such a statement as "I will send all for only 5 dollars, the regular price being 10 dollars, but for a limited time only the price has been reduced to 5 dollars" when such is not the fact.

He agreed also to stop using the word "Special" to designate the price of his products when in fact such price is not special but is the regular and customary price asked in the usual course of business.

The respondent further agreed to desist from the statement "I am the sole owner of 14 patents, grants, and copyrights" so as to imply and mislead the public into believing that he actually owns the specified number of patents, grants, and copyrights, all of which relate to the art of plating or the process of mirror silvering, when in truth such is not the fact.

Legend Not Allowed As Trademark

IN a recent decision, First Assistant Commissioner Kinnan held that Chevy Chase Dairy, of Washington, D. C., is not entitled to register, under the Act of 1920, the notation "Safe Milk for Babies" as a trademark for milk, cream, buttermilk, cheese, and eggs.

The ground of the decision is that this legend or notation does not constitute a trademark as it does not indicate origin or ownership of the goods.

In his decision, after stating that applicant had already registered a composite trademark which included the legend in question, and now seeks to register the legend alone, he said:

"It is believed entirely obvious this legend does not function as a trademark but constitutes a mere laudatory statement as to the character of milk sold by the petitioner. When used upon milk the purchasing public would merely understand this legend to mean that the milk was safe as a food for infants. When used upon the other goods specified, the cheese, butter, eggs, et cetera, the legend would not be interpreted by purchasers to refer to the goods at all but to constitute a mere laudatory advertisement or statement that the petitioner also sold milk of this character."

Description of Function Not Registrable

IT has been held by First Assistant Commissioner Kinnan that the National Licorice Company of Brooklyn, New York is not entitled to register, under the act of 1905, the notation "Helps," as a trademark for licorice cough drops, since this notation is merely descriptive of the goods.

In his decision, after noting the argument that the mark was suggestive rather than descriptive, and pointing out why certain decisions cited in support of that contention were not conclusive of the question, and noting that registration had been refused of certain marks which were descriptive of a quality of the goods such as "Getwell" for a medicine, "Health Food" for a food product, "No-D-Ka" for a tooth paste, he said:

"In view of the foregoing, it seems clear enough the notation here sought to be registered is descriptive of the function or effect of the use of the goods and is, therefore, merely descriptive."

Duplication of Words Voids Trademark

THE mark "White Cap" with or without a representation of ocean waves having white surfaces, is deceptively similar to the mark consisting of the words "White Cap" above a representation of a rounded cap such as is frequently worn by chefs.

Because of this similarity and the further holding that baking powder and self-rising flour are goods of the same descriptive properties, the Court of Customs and Patent Appeals has held that "White Cap" is not registrable for use on "plain and self-

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payment must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AMPHIBIAN AIRPLANE—Having provision for alighting upon water, ice fields, level or otherwise, or desert sands, a stabilizing apparatus functioning in such manner as to retard the descent, in the event of an emergency. Patent 1765214. Frederico G. Diago.

PARACHUTE AND AERIAL LIFE BUOY—Whereby a bouyant body is provided using gas, and a smaller spread to the parachute presenting a floating structure when landing on water, and whereby a comparatively slow descent is secured. Patent 1765075. Edward G. Johnson.

Pertaining to Apparel

WATERPROOF OVERALLS—Which may be open at the front while sitting, but having a shield and drain so that water caught by the opening will pass off at a point exteriorly of the garment. Patent 1765096. Meyer Reingold.

RUBBER HEEL—Having an outer face formed of a plurality of ribs, and grooves spacing the ribs from each other with passages extending lengthwise through the ribs, the body being provided with sockets for securing the heel. Patent 1765155. Harry Heady.

GARMENT—Which may be readily placed upon an infant, secured in place, and conform to the body to allow free movement without binding, and which obviates the need of the ordinary rubber pants, which bind the legs. Patent 1765105. Bertha B. Skinner.

Chemical Processes

PROCESS FOR PURIFYING PEARL ESSENCE—Which consists in bringing the pearl essence to a state of aqueous paste incorporating amyl acetate collodion containing from 8 to 14% nitrocellulose, liberating the water, and washing the product with clean ammoniacal water. Patent 1760771. Jean Paisseau.

FERTILIZING SOLUTION FOR SEED TREATMENT—By treating the seeds with chemical agents so that the chemical action may in due time promote the growth of the plants or increase the quality or the quantity of product therefrom. Patent 1762294. William F. Gericke.

Designs

DESIGN FOR AN ENSEMBLE SUIT—The inventor has been granted two patents, numbers 81394 and 81395. Dorothy Long.

DESIGN FOR A MIRROR STAND—Patent 81345. Frank N. Mariani.

Electrical Devices

ELECTROMAGNETIC IGNITION DEVICE—Adapted to light gas-nozzles, burners, stoves, or fuel mixed flames in general, is very compact comprising but three elements, namely a fixed core, a vibratory blade, a substantially fixed blade, and the usual magnatizing coil. Patent 1763443. Ruggero Righetto.

ELECTRIC TEA URN OR PERCULATOR—Comprising a water vessel, electrically heated, on top of which is a steam-tight vessel, having at its bottom a tea receptacle, and a pipe extending into the lower vessel, allowing steam to be passed through the tea. Patent 1762303. John A. McBride.

GENERATOR CIRCUIT PROTECTOR—Which will automatically shut the current from a generator to a resistance when the current is not being used for charging a battery, or when faulty connections exist between the generator and the battery. Patent 1762297. Elton R. Hopkins.

SHADE HOLDER FOR ELECTRIC LAMPS—A semicircular wire strand, for attachng a glass hood

rising flour," in view of the prior registration of the similar mark for baking powder.

While there is no evidence that the two products have ever been manufactured by the same producer, the opinion states, still their relation to the art of cooking and their use in the production of bread and other food products is such that confusion is likely were similar marks for both registered.

"Suntan" Not a Trademark

THE notation "Suntan" for use on various articles of wearing apparel, including bathing suits, dresses, hosiery, caps, and so on, is not registrable as a trademark in the Patent Office, because descriptive of the goods, the Assistant Commissioner of Patents has ruled.

By extension of the meaning of the term the opinion states, "it now designates not only a color simulating that produced by the sun, but also the characteristic of wearing apparel which permits the direct action of the sun's rays upon portions of the body in order to produce a tanning effect."

Fictitious Names in Business

AN individual doing business under his own name and initials, followed by the word "company," is not required to comply with the provisions of the so-called fictitious name statute, since the name is not fictitious, the Supreme court of California has just ruled.

The statute, the opinion explains, provides that every person transacting business in this state under a fictitious name and every partnership transacting business in this state under a fictitious name or a designation not showing the names of the persons interested as partners in such business "must file with the clerk of the county a certificate stating the name and place of residence of the person or persons interested in the business."

Prior Disclaimer Nullifies Usage

THE disclaimer of any rights to the words "Liquid Solder" in an application for a trademark previously registered precludes a subsequent application to register these words as a trademark, where they have since the disclaimer been registered to another, even though their use by the applicant as a trademark was prior to their registration by the other party, the Court of Customs and Patent Appeals has ruled.

The court overruled a decision of the Patent Office which had ruled that a disclaimer in a trademark proceeding may not be urged, by subsequent users of the mark disclaimed, as an estoppel.

Foreign News Reels Allowed in Italy

THE Italian government ban on the reproduction of foreign dialogue in sound pictures has recently been lifted to the extent of permitting the exhibition of news reels containing foreign dialogue, according to a report received in the Department of Commerce from Trade Commissioner Geroge R. Canty, Paris.

The following is a translation of the communique: "While the existing regulations forbidding the public showing of foreign dialogue pictures are still in force, the ministry of the interior has deemed opportune to concede the permission to show films containing talking sequences and dialogue in foreign languages when such films are taken from real life and reproduce: 'Actualities, ceremonies, sporting tournaments, military exercises, characteristic scenes or events, and so forth.' "

Of Interest to Farmers

CHICKEN ROOST—Which may be suspended from the roof or placed just above the floor, will be proof against lice or other insects, due to the fact that receptacles containing insect-exterminating liquid or powder, are suspended under the roosts. Patent 1760748. Henry Fintel.

AGRICULTURAL MACHINE—Of the disc gang harrow type, whereby the disc blades of each gang may be set to a desired working position so that the soil broken by the leading gang will be further broken by the trailing blades. Patent 1760569. James S. Stewart.

COTTON HARVESTER—In the form of a vehicle adapted to be drawn over the rows of cotton plants with means incorporated for removing the cotton and discharging it into a body mounted on the vehicle frame. Patent 1762045. Arthur V. Benson.

COTTON HARVESTER—Adapted to be moved between rows of cotton plants, and having mechanism for removing cotton directly from the bolls of the plants and placing them in a predetermined manner in a container, ready for bailing. Patent 1763607. Julian E. Watkins

COTTON HARVESTER—Whereby the bolls and open cotton may be stripped from the stalks and the cotton which is left, together with the loose cotton, driven off and carried up by strong currents of air from the machine. Patent 1767979. Bedford Hestand.

RAKE CONSTRUCTION—Which not only facilitates the collection of matter by the rake, but functions effectively to clear its teeth or tines of matter adhering to or impaled thereon providing economy in labor. Patent 1768101. Erwin L. Bell.

Of General Interest

CIGAR LIGHTER—Having a simple and efficient means for throwing sparks from a block of pyrophoric alloy, to ignite a wick, will not readily get out of order, and may be easily assembled, adjusted or repaired. Patent 1762079. Charles Rubsamen.

LOUD SPEAKER—A central cylindrical internally threaded casing, in which a single diaphragm mounted within the casing is adapted to propagate sound waves from a plurality of tone chambers. Patent 1762050. Charles G. Cook.

SPRINKLER HEAD—Which operates with a minimum quantity and pressure of water and in a manner to produce a maximum of slow and even distribution over a given area, particularly adapted for sprinkling lawns and gardens. Patent 1760903. Frederick Henkel.

ROTARY GATE VALVE—In which gates or shoes are mounted on a rotatable element so as to form a tight seal when the valve is closed, but when open a fluid may flow there through without obstruction or the formation of eddies. Patent 1760951. Richard G. Manifold.

COMB AND GLOVE THEREFOR—A form-fitting cover of soft flexible material to be drawn over the teeth of the comb for dressing the hair, the attachment may be readily washed, kept free from dandruff and in a sanitary condition. Patent 1760928. Samuel W. Whitney.

PHOTOMETER AND EXPOSURE CONTROL—The inventor has been granted two patents for the measurement of light to determine the proper length of exposure and manipulation of the camera shutter, in the art of photography. The one is an independent apparatus, the other is attached to the lens for automatically adjusting the diaphragm, and also includes means for finding the proper exposure time. Patents 1762047 and 1762048.

Truth in Sales Schemes

AN individual engaged in selling to retailers such services as sales promotion schemes, advertising data, and specialty merchandise, signed a stipulation with the Federal Trade Commission agreeing to discontinue a number of unfair trade practices.

To retailers he sold merchandise and plans of merchandising involving operation of a lottery. A retailer would buy from him a padlock, a large number of keys, and one of three pieces of merchandise; namely, a radio receiving set, a boy's auto, or a child's scooter, with which he received a supply of advertising hand bills, and window cards. The retailer would then give a key to each customer purchasing merchandise to a fixed minimum amount. When the keys were all distributed, the radio, auto, or scooter would be given as a prize to the customer holding the key that would unlock the padlock.

In selling his products he declared that he manufactured radios, when in truth the respondent did not represent a syndicate or association of advertisers and did not own, control or operate a mill wherein the merchandise he sold was manufactured.

He advertised that certain of his products were offered for sale at factory cost when in fact all of his products were sold at a profit.

He shipped to merchants the instrumentalities and means of conducting a game of chance or lottery, with appropriate literature offering the gift or prize, and encouraged and enabled retail merchants by means of advertising literature to represent that they were selling merchandise at factory cost, when in fact it was sold at a profit.

Motor Bus Accidents Decrease

ONE motor bus passenger in every 1,250,000 passengers carried on buses in Ohio was killed during the last year, it was stated by the chairman of the public utilities commission, Frank W. Geiger, in noting marked improvement in the manner of operating buses since the commission issued a safety order some months ago.

During the year, the chairman said, motor buses carried 32,375,531 passengers, and of these 26 lost their lives in accidents. In this time, he stated, 1032 cars traveled a total of 56,224,254 miles.

Color in Rope Trademarks

THE Assistant Commissioner of Patents has ruled that a trademark for wire rope, consisting of a silver strand which is incorporated in the rope during its manufacture, is registrable in the Patent Office, even though the opposer has a registered trademark for a similar rope consisting of the use of a red strand in the rope.

The Assistant Commissioner found that there would be no confusing similarity between the products as marked by the two different colored strands.

FLAT ASBESTOS-CEMENT ROOF AND WALL SHEET—Constructed to be applied directly to a vertical supporting frame member of a building without sheeting or horizontal supports and without overlapping, is not too flexible or brittle, and will form good insulation against heat and cold. Patent 1763469. Louis Lane.

DISPENSING CONTAINER—For holding sugar, salt, pepper or the like, is sealed against the entrance of moisture, dust or insects, by the mere act of being placed upon a support, the upper end being completely closed. Patent 1763449. Henry T. Trautvetter.

FOLDING CHAIR—Having a canopy readily foldable with the chair, the construction is such that it may be readily set up for use, and easily folded to occupy little space for storage. Patent 1763455. Emil de Bruijn.

PIPE INSULATION—Which may be mechanically constructed in sections, at little cost, and applied to refrigerating pipes and the like, has novel means for sealing the various sections, making the connections both weather and air-tight. Patent 1762276. George J. Schreier.

ATTACHMENT FOR COLLAPSIBLE TUBES—In the form of a discharge nozzle which may be bent with the fingers without closing the passage to provide a terminal at an angle to a tube, to be used as an eye dropper or the like. Patent 1765114. George S. Turner.

BOX—Which may be cut from a single pasteboard blank and shaped to be readily folded into a rectangular box structure having a retaining locking extension and an ornamental upstanding projection on top for receiving decorations. Patent 1765084. Edwin A. Locke, Jr.

PIN HINGE—For an ornament, wherein the hinge is molded on the ornament body as the molten metal cools, the mold parts being readily separable for the removal of the ornament. Patent 1765131. Israel W. Cooper.

ACOUSTIC DEVICE—More particularly a sound generator for radio loud speakers, comprising a diaphragm made in the form of a frustrum of a hollow cone, the sound reproducing apparatus being connected to the smaller aperture of the cone. Patent 1765124. Max P. Bonnat.

COVER HOLDER—For retaining the lid of a cooking vessel, kettle or like receptacle, in position and for preventing unintentional displacement while canting the vessel for the purpose of drawing off liquid. Patent 1765135. Eben G. Doland.

STEAM-PRESSURE COOKER—Which is made of aluminum, with handles formed on opposite sides, with arms and spaced ears extending upwardly, which resiliently clamp the edge of the lid to withstand the steam-pressure. Patent 1765072. Takichi Hashimoto.

CONTAINER HEAD—Constructed of composition material covered with a layer of sheet metal, or fiber, which will provide an effective substitute for a solid wood or all-metal head, and comprises a complete unit. Patent 1764389 Herbert L. and James N. Carpenter.

BALANCED THREE-WAY VALVE—A self-closing valve wherein the outlet ports are so formed as to present a maximum opening, while preventing any parts being interfered with, may be used for many purposes where short admission of fluid pressure is desired. Patent 1765090. George G. Morin.

CLOSURE FOR TOOTHPASTE TUBES—Formed with a rotating closure plate capable of being moved to an open position by the thumb, and moved to a closed position by spring pressure, the structure coacting with a resilient lock. Pa. tent 1765128. Claude A. Conover.

TALLY CARD—Especially designed for use in connection with card games, such as bridge-whist, in which the players are arranged at a number of tables for progressive play, the tally simultanously indicating the games played. Patent 1768020. Joseph J. Arnold.

CONICAL GRATER—Having a removable grating chamber which is provided with a plurality of radially extending barriers adapted to retain the material to be grated against the grating surface. Patent 1768076. John W. and Arthur E. Klensch.

CLIP—Known in the trade as a "money clip" for clamping bills of different denominations and which will permit the ready removal of a single bill from the stack without disturbing the other bills. Patent 1767973. Stanley L. Gedney.

BINDER—Which is strong and durable and adapted to support a book or books or other objects for pivotal mounting in connection with a bookstand, and having means for locking the parts in operative position. Patent 1767978. Walter E. Haskin.

ENVELOPE SEALER—Wherein means are presented for easily receiving and guiding the envelope and its flap so that the flaps will first be moistened and then pressed to a sealed position; the device may be applied to a wall or support. Patent 1767908. Benjamin Zuckerman.

ATOMIZER—In the form of a doll having one or more movable appendages, such as the arms or legs constituting parts of the doll, which may be manipulated to cause atomization of the perfume or other liquid used. Patent 1767911. Benjamin Berko and Joseph Brewer.

PIPE—A tobacco pipe, which may be constructed from a wide range of materials, and so formed that the various parts may be readily aired, cleaned, and kept in a sweet condition. Patent 1767997. Robert W. Nicholls.

COMBINED SEAT AND CARRIER—A combined portable carrying case and seat, which is of simple construction and particularly adapted for outings or picnics for transporting luncheons and various articles for use on the trip. Patent 1767925. Thomas Hargreaves.

ENVELOPE—A remailing envelope of the single pocket type formed of two sheets of paper with flaps disposed in opposite directions, the envelope being adapted to be folded upon itself when remailed as first class matter. Patent 1768164. Nathan Sternheimer.

CONTAINER—Having a hinged closure, and a resiliently raised article holder, which when opened will dispose articles such as cigarettes and matches, etc., to a position where they may be readily grasped. Patent 1768064. George O. Holben.

ATTACHMENT FOR PENCILS—Which may be used for scraping, cutting or clipping bills of lading from packages and the like, the device may constitute a part of the main chamber or be used merely as an attachment for mechanical pencils. Patent 1767948. John C. Taylor.

OARLOCK—Constructed of a minimum number of parts, so that on the pull stroke, roller bearings will engage one side, and on a push stroke the other side, the oar lock may be converted for sculling a boat. Patent 1768006. Arin G. and Harold M. Seberg.

ATOMIZER—By which the heavier hydrocarbons can be reduced to such a fine degree of atomization as to produce substantially perfect combustion, greatly facilitating the cracking in distillation of petroleum. Patent 1764107. Oscar Kay.

BULLET MOLD—For casting hollow-point or solid point bullets as desired, the hollow point is automatically withdrawn when the mold is opened, the bullet readily dropping from the mold after casting. Patent 1763977. Marion G. McNeely.

PANEL CONSTRUCTION—In the form of a removable panel construction, comprising a plurality of frames having panel receiving recesses for tile, marble, plate glass mirrors, which will eliminate waste of labor in assembling and installation. Patent 1763966. Louis Hoffman.

GIFT-DISPENSING APPARATUS — Comprising a board in representation of a rainbow having chutes thereon for dispensing gifts to children, in a manner to carry out the mythical belief that at the end of the rainbow is a pot of gold. Patent 1763733. Alice C. Westgate.

ANGLE TRISECTOR—Having a semi-circular shaped member, a radially-extending arm projecting therefrom, and a curved arm having its ends secured to the semi-circular member, for giving the proper point location for an angle between zero and 180 degrees. Patent 1764581. Sojiro F. Shibuya.

DISPLAY RACK AND STAND—Having novel means for supporting a plurality of racks or casings so that they may be moved in a circuitous path with respect to their supporting member and with respect to each other. Patent 1767980. Raymond S. Hintzee.

Hardware and Tools

SAW TABLE—A movable frame for supporting a circular saw in substantially a horizontal plane, manual means being employed for moving the frame and saw, and its operating means, longitudinally of the table. Patent 1763478. Clarence E. Palmeter.

WINDOW FASTENER—Comprising a corrugated fastening strip secured to the frame and a hinged fastener with tension spring, for locking the window in any position against upward movement but allowing a downward movement at will. Patent 1762280. Arthur J. Slingerland.

DADO CUTTER—A device of simple construction for cutting grooves, whereby a plurality of grooves may be formed of various dimensions through adjustable means for controlling the position of the cutters. Patent 1763463. John Garthe.

COMBINATION CLEAVER, KNIFE AND SAW—Comprising a blade, the major portion of which forms a knife, the remainder being thickened to form a clever-like structure, the construction being such that the back of the blade will support a saw. Patent 1763452. Bert Williamson.

ICE PICK—A pick or awl-like member which may be safely disposed within the handle, when not in use, but may be readily projected and held in active position for breaking ice. Patent 1768035. William E. Domaratius.

SHARPENING DEVICE FOR CURVED-EDGED TOOLS—A manually operable sharpening tool for traversing and conforming to the swing of the curved cutting edge, making it possible to sweep the cutting edge at one stroke and at the proper angle. Patent 1767941. Norris T. Pindar.

Heating and Lighting

REVOLVING BROILER—Wherein different kinds of food to be cooked are carried by suitable supports, and caused to rotate while exposed to view, but remain unmolested until completely cooked, yet may be basted from time to time. Patent 1762035. George Soylian.

APPARATUS FOR UTILIZING SOLAR HEAT—Which includes a chamber adapted to be exposed to the sun rays' and in which the sun's heat is concentrated, a steam generator into which heated gas is introduced under pressure for utilization. Patent 1765136. Charles H. Drane.

COLD-WATER TUBE AND CLEANER FOR DOMESTIC BOILERS AND HEATERS—Wherein a clean-cut tube is provided which may be used

by workmen for cleaning out a boiler or heater or may be used as a combined cleaner and cold water supply pipe. The inventor has been granted two patents of a similar nature. Patents 1767919 and 1768039. William Eiermann.

Machines and Mechanical Devices

LUBRICANT-DISTRIBUTING APPARATUS—By which the various movable parts of an engine or other mechanism, can be automatically lubricated, the feeding being increased or decreased according to the speed of the engine and excess lubrication prevented. Patent 1760902. David Grattan.

BEATER—Which utilizes an electric motor and a form of planetary gearing whereby the beaters or stirring members may be grouped so that certain members will move in a circle and others will rotate in situ. Patent 1762081. George Schleicher.

APPARATUS FOR LIQUEFYING SOLIDIFIED HONEY—Whereby the liquefaction of solidified honey in cans, may be effected in order that the honey may be removed, without discoloration, thus maintaining its original market value. Patent 1761479. Aleck G. Kuykendall.

LOAD-EJECTING APPARATUS FOR CONVEYERS—Such as dredgers, excavators, loaders and trenchers, having buckets or scoops in which loads of material are adapted to be transported and the material completely and automatically ejected therefrom with the utmost ease. Patent 1760964. Harold M. Ruth.

SPEED-CHANGING MECHANISM—Whereby a speed changing device is provided which gives four direct running speeds with three pairs of gears only, the transmission gears serving not only as idlers but themselves contributing to speed reduction. Patent 1762080. Charles Schaefer.

HYDRAULIC ACTUATING MECHANISM—Whereby positive control of the valves is maintained, and the position of the valves, is totally independent of the particular construction of the engine, as the usual valve working rods, levers, and cams are completely dispensed with. Patent 1762068. Heinrich M. M. Mattern, Jr.

FISHING TOOL—For removing from wells broken or lost parts of rotary bits; or other tools used in rotary drilling, in such manner that by removal of the drill pipe the obstructing object may be recovered. Patent 1761463. Govenor K. Beckett.

WELL-CASING SHOE—For use in the sinking of outer or inner casings or screens, to afford means for introducing water under pressure to the lower edge of the shoe for eroding the formation through which the casing is being sunk. Patent 1762012. Elmer D. Every.

COMBINED DRYING, DRUMMING, CLEANING, CAGING AND FINISHING FUR MACHINE—Capable of effectively performing all the necessary steps to condition fur-skins or pelts for commercial purposes, incidentally accomplishing these results with comparative economy as to time, labor, and expense. Patent 1763462. Herman Gabbe.

PLAITED HAT LINING AND METHOD AND APPARATUS FOR MAKING THE SAME—A sewing machine with an attachment for plaiting hat linings in which a stiffening filler piece is employed to connect the side, crown and tip of the lining to give a highly tailored effect. Patent 1763468. Alfred Kurtz.

ROAD-WORKING APPARATUS—Preferably in the form of a power operated vehicle having electromagnetic means adjustably mounted thereon, and to be transported along a road for picking up all ferrous materials or substances injurious to pneumatic tires. Patent 1763457. Charles R. Churchill and Joseph R. Haynen.

FORTILLA-FORMING MACHINE—A cake forming machine embodying a pair of coacting dough pressing rollers having means for detaching the dough from one roller and subsequently detaching the cut or stamped cakes from the other roller. Patent 1763445. Luis Romero.

DRAWING-IN-FILLING PREVENTER—For preventing the catching of the remaining filling on a bobbin between the shuttle and box plate of the loom, and the breaking off at a moment of transfer of a new bobbin from the magazine. Patent 1763456. Theophile Caux.

SPRAY GUN—Which has novel means for actuating the air valve and paint valve simultaneously, whereby there will be no frictional contact, and means whereby the spray may be changed from a round to a flat. Patent 1762282. Emil H. Stephan.

AUTOMATIC SASH MACHINE—For use in the manufacture of window stiles, wherein means are provided for feeding the stiles to the machine, boring, grooving, molding the stock on two edges, and dressing to a desired thickness, in a series of operations. Patent 1762273. David B. Mackenzie.

POWER STEAM-FEED LEVER—For operating the steam feed valve in a saw mill by mechanical power, which will eliminate fatigue on the part of the operator in using the hand-operated devices usually employed. Patent 1765069. Edwin J. Gibson.

PUMP—Primarily designed for oil wells in which one or more controlling pistons are positively manipulated from above the surface of the ground, either hydraulically, mechanically, electrically, or by air or gas pressure. Patent 1765085. Harley H. Markey.

SEMIAUTOMATIC DIPPER TRIP AND MONKEY-LINE WINDER—A re-winding mechansim for monkey lines, wherein the line may be maintained taut, taken in and allowed to slacken as desired, for maintaining a clam shell bucket in a swinging or desired position. Patent 1765089 George G. Morin.

SHIP-UNLOADING DEVICE—Whereby means are provided for quickly conveying merchandise from the hold to the deck, and by a chute directly from the deck to the quay or lighters, without encumbering either the hold or the deck. Patent 1765118. Mario Abriani.

DISPENSING DEVICE—Which is adapted to dispose in bottles predetermined amounts of liquid with means for varying the amount disposed, the operation continuing until the entire amount of liquid in the machine has been disposed of. Patent 1763971. James Kantor and Charles H. Miller.

SUBMARINE - SALVAGING APPARATUS — A suitable number of floats carried by a submarine are released by the sunken boat, whereby a salvaging crew, with the aid of a mother ship, may raise the submarine without requiring divers to be sent down. Patent 1765101. John Schierenbeck.

LAWN MOWER—Particularly adapted for cutting grass located adjacent to the trunks of trees or close to fences, walks, bushes or other parts adjacent to a lawn which have been inaccessible by the conventional type of mower. Patent 1762287. John H. Blair.

VENDING MACHINE—Adapted more particularly for vending flat articles, such as newspapers, periodicals, etc., a slidable drawer permitting the delivery of the article after a required number of coins have been deposited. Patent 1765216. Major Duncan.

BOILER FLUE AND PIPE CUTTER—In which a circular knife is moved into contact with a revolving pipe to be cut, a motor causing operation of rotating means, revolving means being manually actuated for causing the cutter to engage the pipe. Patent 1765208. James I. Cunningham.

SHEET-CUTTING MACHINE—A rotatable work support and conveyer for moving rubber sheet material in a longitudinal direction for cutting sheets at predetermined points as the rubber is fed from the calendar. Patent 1765184. Elno H. Trump.

BOTTLE WASHING MACHINE—In which the bottles are inverted and successively fed over jets of fluid containing solid objects such as rubber spheres, which are projected for removing foreign matter both from the interior and exterior of the bottle. Patent 1761492. Frank B. Reily.

BIT-FORMING MACHINE—With which uniform shaped bits of comparatively superior construction may be produced expeditiously and for sharpening used bits of uniform shape, may be adjusted to different sizes. Patent 1767881. Jeremiah V. Gustin.

PUMP—A rotary high speed submerged verticle type; the blades of the water wheel being constructed to obtain a greater lift in proportion to the horse power required, especially useful for irrigation purposes. Patent 1768130. Robert L. Meaux.

LOCK—Designed to be gravitationally locked and electrically released although intended to broadly cover mechanical releasing means, particularly adapted for sliding closures, such as cages in banks, is simple and highly efficient. Patent 1768021. William E. Bauerband.

MULTIPLE-SPEED TRANSMISSION MECHANISM—Which includes a shiftable carrier composed of sections which are sleeved on the drive and driven shafts, whereby various combinations of gearing and different speeds will be effected. Patent 1767909. Herbert G. Altvater.

WATCH-CRYSTAL-FITTING DEVICE—Whereby the pattern and size of crystal may be readily and accurately traced on a crystal blank directly from the inside edge of the bezel of the watch case to which the finished crystal is to be applied. Patent 1767935. James B. McDaniel.

CUTTING AND GRINDING MILL—For feed, silage, etc., having a stationary cutting knife at the entrance of the machine in connection with the rotary cutters, whereby the material will be cut into pieces before grinding so that no choking of the machine will occur. Patent 1767921. Steve R. Gately.

MACHINE FOR CLEANING COTTON AND THE LIKE—Which continuously utilizes the same current of air, so that the moisture content may be relied upon as being substantially uniform, and the change of air at short intervals obviated. Patent 1767957. John S. Bachman.

FLOOR POLISHER—A unitary structure which may be readily applied to the floor and easily operated with means for adjusting the horizontal position of the brushes. Patent 1767983. William H. Hughes.

CLOSURE-OPERATING MECHANISM—By which doors, particularly garage doors, are adapted to be automatically opened or closed according to the vehicle approaching or leaving the garage, thus obviating annoyance in inclement weather. Patent 1764150. George G. Candee.

APPARATUS FOR AUTOMATICALLY DETERMINING AND RECORDING THE SPECIFIC GRAVITIES OF FLUIDS—For use in measuring gases, natural or artificial, flowing through pipes, where due to the mixture of different densities, it is desired to have a record of the specific gravity at all times. Patent 1764103. Harry A. Hurley and Herbert J. Tones.

STREET-MARKING APPARATUS—Having one or more brushes, each rotatable about a vertical axis, in a manner to produce a painting motion for marking highways with lines for defining pedestrian and vehicular traffic zones. Patent 1764546. William B. Burnley.

Medical and Surgical Devices

WOMB MEDICAL APPLICATOR—Comprising a ring of semi-flexible material, and a receiving bag associated therewith, with inwardly extending loops adapted to receive and apply a medicament to the cervix and associated portions of the female anatomy. Patent 1760751. Jose L. M. Guenard.

TEST-TUBE RACK—Composed of several parts which can be nested and conveniently carried from place to place in a satchel and set up for supporting the tubes during the heating and cooling action, and the draining and drying. Patent 1763461. Charles Fowler.

Musical Devices

MUSIC-TEACHING DEVICE—Having a staff board and a number of lights representing notes on the scale, the lights being controllable by the teacher, whereby the students will quickly learn to sing at sight from the illuminated notes. Patent 1763444. Michael B. Rock.

MUSICAL INSTRUMENT—Especially designed for use in children's bands, as a foundation for other instrumental work, it being constructed to start the coordination of the tongue, lipping and fingers, as used in wood wind instruments. Patent 1767998. William B. Parkinson.

Plumbing and Fittings

PLUMBING FIXTURE—A pressure trap, having in combination therewith a pivoted buoyant valve member adapted to control the flow of fluid therethrough in a predetermined direction, the whole forming a simply assembled and disassembled fixture. Patent 1763466. Albert M. Khun.

PLUMBING FIXTURE—A back pressure trap with leverage means for controlling the movement of an associated valve whereby the flow of fluid is confined to a predetermined direction and back pressure is prevented. Patent 1765078. Albert M. Khun.

Prime Movers and Their Accessories

VALVE MECHANISM FOR INTERNAL-COMBUSTION ENGINES—A valve in the form of a vertically positioned sleeve mounted to turn in a circular groove in the head of the engine, and held in place by a top plate, annular gear teeth imparting the turning movement. Patent 1763460. Jesse F. Fisk.

REVERSING GEAR FOR RECIPROCATING ENGINES WITH HYDRAULICALLY-OPERATED VALVES—Whereby reversing is effected by altering the admission and discharge of the fluid to and from the pistons, by means of cocks or other control devices in the corresponding pipes for the liquid. Patent 1763474. H. M. Meier Mattern.

VALVE LIFTER—Adapted to be operated in conjunction with spring-actuated poppet valve members of an internal combustion engine, affording a positive vertical lift, simplicity in operation, extreme power, and insuring a positive lock at any height of lift. Patent 1765138. Willard J. Dunston.

VALVE—Having novel means for directing the exhaust gas away from the valve head in an internal combustion engine, preventing the warping and leaking of the valve and keeping the valve head cool. Patent 1763951. Carl F. Burgmann.

ENGINE—Of the two-cycle principle, in which the customary piston is inverted and the explosion of the gas takes place within the interior of the piston, a novel water jacket cooling the inside and outside. Patent 1763959. Fred F. Finch.

VALVE-SPRING-LIFTING TOOL—For compressing the coil spring around the stem of a poppet valve of internal combustion engine to release the tension upon its supporting pin so that the pin may be withdrawn and the valve removed. Patent 1764519. Arthur L. Mettler.

Railways and Their Accessories

RAIL FASTENING—Including a fastener plate formed substantially H-shaped and having overhanging shoulders with the parts formed to be secured to ties by spikes, welding, rivets or other securing means. Patent 1760723. John G. and Arthur N. Snyder.

DIRIGIBLE HEADLIGHT—For locomotives, or the like, having a support responsive to gravity to cause the light to automatically illuminate the track in advance of the locomotive, whether the latter is traversing a curved or straight stretch. Patent 1761484. George G. McNee.

FLANGE OILER—For oiling locomotive wheels whereby the lubricant may be directed against the flange of the wheel which is brought into direct contact with the sides of the treads of the rails. Patent 1765202. James C. Burford.

AIR-ACTUATED MECHANISM FOR LOCKING THROTTLE LEVERS—Wherein the air employed for positively locking the throttle lever may be passed to a bell-actuating mechanism for notifying persons upon the train or there around that the trajn is to be set in motion. Patent 1763954. William M. Cross.

COMBINED TIE PLATE AND RAIL ANCHOR—Which will rigidly hold the rail against lateral or longitudinal displacement, obviates the need of the ordinary tie plate and protects the tie, and acts as a brace for the rail. Patent 1767937. William A. McFarland.

SIGNAL RECORDER—A recording mechanism for each actuation of a signal, which embodies a horological instrument and a pressure actuated time stamping mechanism operable incident to the action of the signal, or the actuation of a whistle on the locomotive. Patent 1768154. Harry O. Sampson.

Pertaining to Recreation

TOY PALPITATING HEART—A toy of novel construction which may be used to simulate the action of a palpitating heart, for the purpose of surprising and amusing onlookers. Patent 1763467. Herman H. D. Klinker.

SWIMMING DEVICE—By means of which persons not experienced in the art of swimming are able to keep afloat on the surface, to increase the efficiency of the stroke, and thereby reduce the muscular force exerted in swimming. Patent 1765116. Linwood R. Williams.

GAME BOARD—Of the type in which objects moving about the surface of the board are controlled by a player, the board having a resilient mounting, may be readily tilted to various angles and inclinations. Patent 1768016. Arthur L. Walker.

SKI SLED—Which may be used as a sled and the runners thereof being in the form of skiis, may be readily detached for use in the usual manner for sliding over freshly fallen snow. Patent 1768046. Christian Fredrickson.

Pertaining to Vehicles

VEHICLE—A pedal-operated device whereby smooth operation will be insured during all the various stages, and having means whereby the vehicle may turn a corner at a high rate of speed, with a minimum risk of overturning. Patent 1758957. Robert G. McKay.

PARKING DEVICE FOR MOTOR VEHICLES—A simple attachment which may be used with a standard automobile, whereby the front wheels may be lifted and the rear end wheels swung about as a pivot, until a curbing, or the like is paralleled. Patent 1758964. John Myers.

RUMBLE-SEAT TOP—Which is incorporated in the car body during manufacture and completely housed in the seat structure when not in use, but readily capable of extension to completely house the occupants when required. Patent 1760334. Otto Altenbach.

MOTOR-VEHICLE SEAT—Particularly adapted for use in connection with the driver's seat, whereby the seat is so constructed that it may be adjusted to alter the vertical height to that most comfortable for the driver's personal use. Patent 1762046. Albert B. Blumenberg.

LINING-GUN NOZZLE—Comprising a tapered tubular intake stem and a form of hair-brush or pencil, designed to be drawn along a moulding or the plain surface of a motor car, a drip container catching any surplus liquid. Patent 1762058. Herbert H. Harris and William T. Whittingslowe.

STEERING GEAR—In which the engine or motor is utilized to shift the angular disposition of the wheel, it being only necessary for the operator to initiate the movement. Particularly adapted for heavy vehicles requiring great strength. Patent 1763470. George E. Lemon.

SIGNAL MECHANISM FOR AUTOMOBILES—For automatically lighting the lamps at the front and rear to indicate turns, the mechanism being manually actuated, and independently functioning for lighting the lamps in different sequence, to indicate the turning motion. Patent 1763465. William F. Hild.

DEVICE FOR SUPPORTING ARTICLES ON TIRES OR THE LIKE—For supporting, for instance, a mirror, on the spare tire, commonly carried on the running board, of an automobile, in such position that it may be conveniently observed by the driver, but secured against theft. Patent 1765099. Abraham W. Rosen.

MOTOR-VEHICLE BRAKE—Wherein the brake band has one end fixed and its other end movable so that upon application of operating pressure the entire band will be circumferentially expanded against the brake drum. Patent 1768176. Gus Walker.

RECORDING DEVICE FOR AUTOMOBILES—Which may be secured to the instrument board of a car, and swung from behind the latter into position for quickly recording various data relating to gasoline filling, oil, etc. Patent 1767924. Nelson L. Greene.

SIGNAL DEVICE FOR MOTOR VEHICLES—An arm type of signal, for extension outwardly from the side of the vehicle to indicate to the drivers of other vehicles the stopping, slowing, or direction of turn, the device is manually controlled. Patent 1768034. John Deblieux.

CARD HOLDER—Whereby a certificate or owner's registration card or the like, may be securely fastened in a conspicuous place on a part of the automobile, and means for preventing substitution of another card. Patent 1767993. Adolph G. Lorenz.

THEFT-PROOF TIRE-VALVE CAP—A simple device which will be under control of an authorized person to make possible the application or removal of the valve stem cap, but impossible for unauthorized persons to remove the cap. Patent 1767884. Harison Heinrich.

AIR-PRESSURE GAUGE—A gauge for use in connection with an attachment employed for inflating tires, the device is of simple construction and arranged to permit the gagging and indicating of various pressures. Patent 1768275 William C. Urton.

Mechanical Engineering

Learn at Home

MECHANICAL Engineering embraces the design, construction and operation of machines and machine tools. It is a profession which offers almost unlimited opportunities to men who combine natural mechanical ability with technical training.

For this is The Age of Machinery. Almost every convenience, luxury or necessity which we enjoy depends on machinery for its production or adaptability to our needs. Every new invention multiplies the opportunities for competent designers, builders, erecting engineers, etc.

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